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THE LARVAE OF THE COCCINELLIDAE

WITH SIX PLATES

BY

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1919

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INTRODUCTION

The adults of this family are known to most persons as lady-bugs or ladybirds. Their distinctive characteristics are the apparently three-segmented tarsi and the broad hatchet-shaped distal segment of the maxillary palpi. Other characteristics are: the eleven segmented antennae, in which the distal segments are commonly modified to form a more or less distinct club-shaped enlargement; the insertion of the antennae near the mesal margin of the compound eyes; the ventral direction of the mouth; the retraction of the head into the small transverse prothorax; the transverse front coxae; the closed coxal cavities, except in Coccidula; the convex elytra; and the abdomen consisting of five to seven exposed ventral segments.

Le Baron has said, in speaking of this family, that "The Coccinellidae occupy a remarkably anomalous and isolated position. Whilst having the rounded form of the plant beetles, the clavate antennae of the scavangers, and the dilated palpi of the fungus beetles, they agree in food and habits with none of these, but resemble in their predaceous habits the ground beetles and the soft-winged carnivora, all of which have their bodies more or less elongated, their tarsi five-jointed, their antennae filiform, and their palpi slender or moderately dilated."

The larvae of the Coccinellidae, though they may be known to many people, are not as a rule associated with the adult coccinellids or lady-bugs. The most distinctive characteristics of these larvae are: their porcupine-like appearance; elongated body which is usually striped or mottled with red, black, white or yellow areas; small three-segmented antennae; powerful mandibles; and the habit of being continually on the move. From the systematist's point of view these larvae do not show any unusual characteristics such as Le Baron has noted for the adults, for they resemble in most respects the distinctly predaceous types of coleopterous larvae. This is true even of the Epilachninae, which are phytophagous. With the exception of this subfamily the Coccinellidae are all more or less predaceous in their adult stages, and almost entirely so in their larval stages.

The purpose of this investigation is to study the morphology of coccinellid larvae and to arrange tables for the identification and classification of a few of the more common species. The work has been limited to those genera and species which have in the main been found in or reported from Illinois. Specimens were collected and bred during the autumn of 1918, and others were obtained from the collections of Dr. A. D. MacGillivray, the University of Illinois, the Illinois State Natural History Survey, and a specimen of *Brachyacantha ursina* received from Cornell University.

The investigation of the immature stages of insects was to a great extent neglected by entomologists until about the beginning of the twentieth century. There has been some previous work done, however, upon the immature stages of the Coccinellidae. The works of L. Ganglbauer (1899), Dimmock (1906), Palmer (1914), and Böving (1917) are valuable to one pursuing a study of the immature stages of these beetles.

I am greatly indebted to Dr. A. D. MacGillivray, under whose supervision this work was carried on, for the interest he has shown at all times, for the use of specimens from his collection, and for the privilege of using the morphological nomenclature which he has devised. I am likewise indebted to Professor S. A. Forbes for the use of material belonging to the Illinois State Natural History Survey, and to Professor J. G. Needham for the loan of material from Cornell University.

MORPHOLOGY

This discussion of the general comparative morphology of coccinellid larvae is based for the most part upon a study of *Chilocorus bivulnerus*. This species represents the most generalized condition of the carnivorous coccinellids that I have studied. A still more generalized condition occurs, however, in the subfamily Epilachninae, the members of which are for the most part entirely phytophagous.

HEAD

The heads of coccinellid larvae are symmetrical and the general outline is circular or nearly so, except in the genus Microweisea in which it is oval or oblong. In Chilocorus and Epilachna the mouth is directed ventrad; while in all of the genera of the Coccinellini, Hyperaspini, and Microweiseini it is directed caudo-ventrad. The greatest departure from the generalized condition is found in Scymnus. In this genus the mouth is directed cephalad. For the sake of convenience the head will be considered under two divisions; first, the fixed parts; second, the movable parts.

Fixed Parts of the Head

The fixed parts of the head consist of an external and an internal skeleton. The external skeleton is composed of the fused front and postclypeus, preclypeus, veterx, labrum, and gula. The boundaries of these sclerites are marked by distinct furrows or sutures. The internal skeleton is made up of the floor-like tentorium, which in the Coccinellidae consists of three parts.

In the head capsule of *C. bivulnerus* the epicranial suture (Fig. 6, *es*) is present on the meson. It extends from the occipital foramen (Fig. 17, *of*) to a point on the cephalic aspect about one-third the distance from the occipital foramen to a line drawn through the antennal fossae. This part of the epicranial suture is the epicranial stem (Fig. 6, *es*). The epicranial stem bifurcates at its ventral end and the two epicranial arms (Fig. 6, *ea*) extend latero-ventrad a short distance, then make a broad curve and extend ventro-mesad on each side to a point where they become much thickened. Each thickening is a pretentorina (Fig. 6, *pt*) and marks the point of invagination of the pretentorium. The epicranial arms curve broadly laterad and ventrad from each pretentorina to a point dorso-mesad of an antennal fossa where they become obsolete. The three sclerites included within or ventrad of the fork of the epicranial stem are the fused front and postclypeus (Fig. 6, *fc*) and the labrum (Fig. 6, *l*). There is an indistinct furrow which marks the position of the clypeal

suture (Fig. 6, *cs*) on each lateral margin of the head. There is a distinct precoila (Fig. 6, *pcl*), in which a preartis articulates, located on each side of the postclypeus meso-ventrad of the antennal fossa at the point of origin of the clypeal suture. The vertex occupies all of the dorsal and lateral parts of the head capsule not included within the fork of the epicranial suture (Fig. 6, *v*). There are six ocelli (Fig. 6, *oc*), in two groups of three. Each group is situated on the lateral margin of the vertex dorsad and laterad of the lateral end of an epicranial arm. The antennal fossae are located ventrad of the ocelli on the dorso-lateral margin of the vertex. The large somewhat oval opening in the caudal aspect of the head is the occipital foramen (Fig. 17, *of*).

A primitive type of epicranial suture is found in the adults of Periplaneta and the larvae of Corydalis. The condition of the epicranial suture in *C. bivulnerus* is very similar to that of these primitive forms, except that the epicranial stem is not so long in proportion to the length of the epicranial arms and that a portion of each arm is wanting near the antennal fossae. This suture in Epilachna (Fig. 4, *es*) very closely resembles that of *C. bivulnerus*, but the epicranial stem is much longer and extends almost one-half the distance from the occipital foramen to a line drawn through the antennal fossae. In Megilla the epicranial suture (Fig. 7, *es*) is present but very short, not extending more than one-fifth the distance from the occipital foramen to a line drawn through the antennal fossae; while in Adalia, Anatis, Hippodamia, Coccinella, and Microweisea the epicranial stem is not present and the epicranial arms diverge immediately from the occipital foramen. In the adult larval stage of Hyperaspis the epicranial suture is wanting, but it is present in the first instar. The epicranial stem is absent in the second instar, but the epicranial arms are present; while in the later larval instars the entire epicranial suture is wanting. The adult larvae of Scymnus (Fig. 14) also lack an epicranial suture; no observations were made on the conditions present in very young larvae.

The epicranial arms are present in most coccinellid larvae, but are absent in the adult larvae of Scymnus and Hyperaspis. In *C. bivulnerus* the epicranial arms extend ventro-laterad from their point of origin to a point dorso-mesad of the antennal fossae. In Epilachna the epicranial arms extend ventrad of the antennal fossae, but do not extend as far laterad. In Chilocorus and Epilachna the epicranial arms are not widely divergent, but in all of the genera of the Coccinellini they diverge widely and become obsolete slightly ventrad of the antennal fossae. In the first larval instar of Hyperaspis they diverge immediately upon the dorsocephalic aspect of the head, the epicranial stem being very short, and they extend laterad almost parallel with the caudal margin of the head, make an abrupt turn and extend laterad and ventrad to their point of obsolescence. In Microweisea (Fig. 13) the epicranial arms diverge gradually

latero-ventrad and become obsolete dorsad of the antennal fossae. Due to the extreme length of the head in this genus, these arms are very long. In Scymnus the epicranial arms are entirely wanting.

The two proximal unpaired sclerites between the arms of the epicranial suture in Corydalis are the fused front and postclypeus. These areas are separated from each other in the more generalized forms by the fronto-clypeal suture; in the specialized forms, however, they may become completely fused. In such cases the fronto-clypeal suture is absent, but portions of it may be indicated by a furrow on each lateral portion of the head. These portions extend mesad from near the precoila. In *C. bivulnerus* and all coccinellid larvae the front and post-clypeus (Fig. 6, *fc*) are completely fused and the fronto-clypeal suture is wanting. The clypeal suture (Fig. 6, *cs*) is indicated by an indistinct furrow extending mesad from the precoila (Figs. 5 and 6, *pcl*). The area ventrad of this furrow in the preclypeus (Fig. 6, *pc*) and the area dorsad of it is the fused front and postclypeus (Fig. 6, *fc*). In Epilachna (Fig. 4) the front and postclypeus are entirely separated from the preclypeus by the complete clypeal suture; while in all of the other genera of the family that were studied the condition of the clypeal suture is approximately that found in Chilocorus.

The labrum of *C. bivulnerus* is the distinct, slightly chitinized, shield-like sclerite attached to the ventral margin of the preclypeus (Fig. 6, *l*). The ventral margin of the labrum may be slightly emarginate and usually bears four or six medium-sized setae. In general the structure of the labrum in all of the coccinellids studied approximates very closely the condition found in the labrum of *C. bivulnerus*. Its general shape, however, varies in the different genera of the family. In the genus Epilachna the labrum varies most widely from the Chilocorus type. In this genus it is broadly transverse and widely but shallowly emarginate on the ventral margin.

The vertex of *C. bivulnerus* (Fig. 6, *v*) consists of the paired continuous areas on the cephalic and dorsal aspect of the head. In Chilocorus, Epilachna, and Megilla the epicranial stem is present and marks the line of separation of the two halves of the vertex; in Hippodamia, Coccinella, Anatis, Adalia, and Microweisea the epicranial arms alone are present and the two halves of the vertex do not meet on the meson, but a portion of the front extends between them to the occipital foramen. In Hyperaspis and Scymnus the epicranial suture is absent and the front, postclypeus, and vertex are fused. The vertex is continuous on its lateral and caudo-lateral margins with the genae (Fig. 5, *ge*), the region of the vertex ventrad and mesad of the ocelli and the antennal fossae. The size, shape, and extent of the vertex is dependent upon the location and extent of the epicranial suture.

In the head of Corydalis caudad of the antennae there is a distinct ocularium which bears five or six ocelli. This indicates the position of the developing compound eyes. In *C. bivulnerus* the ocelli (Figs. 5 and 6, *oc*) are placed three on each lateral aspect of the head dorsad of the antennal fossae. They are usually arranged in the form of a triangle. These ocelli are undoubtedly the homologues of the ocelli of Corydalis and represent the developing compound eye of the adult. The arrangement, number, and position of the ocelli is fairly constant in all of the genera of the family. There is only one exception worthy of note; the region bearing the ocelli in Scymnus is darkened and slightly chitinized. Two of the ocelli are equal in size, while the third is almost twice as large as either of the others.

In generalized insects the gula is present as a distinct chitinized sclerite extending cephalad from the occipital foramen to the articulation of the maxillae and submentum. It is bounded on its lateral margins by the postgenae. In all of the larvae of the Coccinellidae the gula (Fig. 17, *g*) is present as a more or less membraneous, rectangular, glabrous area caudad and dorsad of the submentum.

The internal skeleton of the head of insects is formed by invaginations. It serves undoubtedly to make the head more rigid, to support the soft and delicate parts, and as a place for the attachment of muscles. The entire internal skeleton of the head is known as the tentorium (Fig. 47). It consists of two or three pairs of arms that have been invaginated from the external skeleton. In the more primitive forms there may be only two pairs. In all of the larvae of the Coccinellidae there are three distinct pairs of arms.

The pretentoria, also known as the anterior arms of the tentorium (Fig. 47, *prt*), are invaginated on the dorsal aspect of the head near the point where the epicranial arms turn abruptly laterad.

The supratentoria, sometimes called the dorsal arms of the tentorium (Fig. 47, *sup*), are invaginated mesad of the antennal fossae and are well developed in the larvae of the Coccinellidae.

The metatentoria or the posterior arms of the tentorium (Fig. 47, *met*) are invaginated on the ventral aspect of the head near the articulations of the maxillae.

In many insects the occipital foramen is divided into two parts by a distinct bridge. This bridge is the corpotentorium. In coccinellid larvae the corpotentorium is not united to form a complete bridge, but the mesal boundaries of the two lobes which ordinarily fuse to form the corpotentorium (Fig. 47, *cp*) approximate each other very closely on the ventral aspect of the head and are located much nearer the mouth than the occipital foramen. The metatentoria extend dorsad from their point of invagination along the gular sutures toward the occipital foramen and form important landmarks for the identification of the gula. When they

reach the occipital foramen, they diverge laterad and form a ring around the entire opening.

The small bridge-like structure about one-half way between the lobes of the corpotentorium and the occipital foramen is the laminitentorium (Fig. 47, *lt*). It is formed by the fusion of the ends of the pretentoria, supratentoria, and metatentoria.

The small pit on the ectal surface of the dorso-cephalic aspect of the head where each pretentorium is invaginated is a pretentorina (Fig. 4, *pt*). The point on the ectal surface of the head marking the place of invagination of each supratentorium is a supratentorina (Fig. 6, *supt*). It is not present as a pit in coccinellid larvae. The metatentorina is the point of invagination of each metatentorium on the caudo-ventral aspect of the head. The metatentorinae are not indicated by a pit or thickening.

Movable Parts of the Head

The form, structure, and arrangement of the movable parts of the head of coccinellid larvae are readily homologized with the movable parts of the head of generalized insects, such as Periplaneta or the larvae of Corydalis or the adults of the Carabidae. The movable parts consist of the antennae, mandibles, maxillae, and labium.

The antennae of *C. bivulnerus* (Fig. 36) are about as long as wide, slightly conical, and composed of three segments. The scape (Fig. 36, *sc*) is cylindrical, wider than long, slightly chitinized, and bears a few fine setae. The scape is attached to the heavily chitinized antennaria which bounds the periphery of the antennal fossae (Fig. 36, *ant*) by a delicate membrane, the antacoria (Fig. 36, *antc*). The pedicel or second segment (Fig. 36, *pd*) is distinctly smaller than the scape, about as wide as long, and bears a distinct long seta on its mesal surface near the distal end. It also bears a small number of fine setae. The flagellum, the small mound-like segment on the distal end of the pedicel (Fig. 36, *fl*), usually appears to be a part of the pedicel, but careful examination shows it to be distinctly separated from it. The flagellum usually bears three peg-like setae which are probably tactile organs (Fig. 36, *ts*) and four small oval openings which are probably sensoria (Fig. 36, *se*).

The antennae of Epilachna (Fig. 35) are about three times as long as wide; the greater part of the elongation is found in the pedicel. In this segment the peg-like seta at the distal end is clearly a part of the pedicel and does not appear as a part of the flagellum as in the other genera of the family. In all of the genera of the tribe Coccinellini and in the genus Microweisea the antennae are less than twice as long as wide and the antacoriae are protuberant and might easily be mistaken for the first antennal segment. The condition of the remaining parts is similar to that of Chilocorus. In Hyperaspis the antacoria (Fig. 38, *antc*) is more pro-

tuberant than in the Coccinellini, the flagellum is more mound-like, and one of the three apical setae is much larger than the other two. Scymnus (Fig. 39) presents a type of antennae that shows a wide variation from the type found in the other genera of the family. The antenna of this genus is wider than long, only slightly chitinized, scarcely elevated, and conical. The antacoria (Fig. 39, *antc*) is narrow; the scape (Fig. 39, *sc*) is about three times as wide as long; the pedicel (Fig. 39, *pd*) is about twice as wide as long, its distal end much narrower than the proximal; and the flagellum (Fig. 39, *fl*) is more or less mound-like and about twice as wide as long.

All of the coccinellid larvae examined have well-developed mandibles. They may be of a crushing type, that is with many dentes as in Epilachna, or they may be of a piercing type, that is with one or two dentes as in all of the members of the subfamily Coccinellinae. Within the family there are all stages of variation between these two extremes. The type of mandible found in such generalized genera as Periplaneta or Corydalis is that with many dentes. This tends to show that in these forms the mandible is a crushing organ primarily and not for piercing as appears to be the case in the specialized coccinellid larvae.

The mandible of *C. bivulnerus* (Figs. 40, 41) is of moderate size, heavily chitinized, somewhat triangular in outline, thick and heavy at the proximal end, and tapering to a bidentate distal point. The proximo-mesal margin of each mandible is provided with a distinct wedge-shaped mola (Fig. 41, *mo*) and the proximo-lateral margin with a stout spine-like seta. On the cephalo-mesal margin of each there is a preartis (Figs. 42, 41, *ps*) which articulates in a precoila (Fig. 5, *pcl*); on the caudo-mesal margin there is a postartis (Fig. 41, *poa*) which articulates in a postcoila. The mandibles of Chilocorus are intermediate in form between the two extreme types. The majority of the species studied have mandibles similar to those of Chilocorus and tend to show an evolution from the multidentate type found in Epilachna, which are entirely phytophagous, to the unidentate type found in Hyperaspis, Microweisea, and Scymnus, which are entirely carnivorous. In all of the genera studied the mola is present, but it is much reduced, is almost indistinguishable in Epilachna (Fig. 42, *mo*) and shows the extreme condition of its reduction in Microweisea. The mandibles of all coccinellid larvae are connected with the head capsule cephalad and ventrad of the antennal fossae by a small and distinct membrane. This membrane is the mandacoria (Fig. 5, *mco*). The extensor muscles are attached to the lateral margin of the mandible between the preartis and the postartis, while the retractor muscles are attached near the mesal portion of the mandible.

The maxillae of the Coccinellidae show a greater degree of departure from the primitive type than any other of the movable parts. They resemble in general form the maxillae of Periplaneta and the larvae of

Corydalis, but show a more striking resemblance to the conditions found in the maxillae of carabid larvae. Though the coccinellid maxillae are similar in form to those of Periplaneta or to those of the larvae of Corydalis, they also show a great difference in structure and are much more specialized than those of carabid larvae. In order to homologize the parts of the maxilla, it was necessary to trace the development of this appendage from the more generalized to the more specialized condition. In the tracing of this development maxillae of the larvae of Carabidae, Lachnosterna, Elateridae, and Curculionidae were found most useful.

Each maxilla of *C. bivulnerus* is moderately large, slightly chitinized, and consists of the following parts: a fused cardo and stipes, a palpifer, a maxillary palpus, and a galea. The lacinia is apparently wanting.

In the primitive type of coleopterous larvae the cardines are composed of two sclerites; the subcardo, which articulates with the postcoila and a second sclerite, the alacardo, which lies between the subcardo and stipes. This condition is found in the larvae of Pterostichus and Lachnosterna; while in the larvae of a curculionid beetle, Phytonomus, the subcardo and alacardo are fused. A similar condition is found in the larvae of the Elateridae. In the Coccinellidae the subcardo and alacardo are not only fused to form the cardo, but the cardo and stipes are fused and the extent of the cardo is only indicated by small and in many cases indistinct notches along the sides of the fused cardo and stipes. This indication of the suture between the cardo and stipes is found in the maxillae of all of the larvae studied and there is but little variation shown. It will be seen from the above that the stipes and cardo must be discussed as one sclerite. This sclerite (Fig. 18, *ss+ca*) occupies the area at the proximal end of the maxilla cephalad or ventrad of the gula. Its form in *C. bivulnerus* is that of a rectangle. It is about as wide as long, slightly setaceous, and chitinized. This general form of the stipes and cardo is found in all of the genera studied except Microweisea, Scymnus, and Hyperaspis. In these genera the stipes and cardo are narrow and elongated. In Microweisea and Hyperaspis the proximal end is curved laterad. This curved portion represents the cardo and the remaining part of the sclerite is the stipes.

The palpifer is present as a distinct shoulder-like area (Fig. 18, *pf*) near the distal margin of the fused stipes and cardo. Its form and position are generally constant in all of the genera studied. This area bears at its distal extremity the three-segmented maxillary palpus. The maxillary palpus (Fig. 18, *mxpl*) is well developed in all of the genera. In *C. bivulnerus* they are stout and slightly chitinized. The first segment is cylindrical, wider than long, and usually with one or two small setae. The second segment is longer than wide and with one or two large setae. The third segment is conical, about one-half as long as wide with two or three setae and with a group of sensory organs at its distal end. The maxillary palpus

in Epilachna (Fig. 16, *mxpl*) is much elongated, the proximal segment is nearly twice as long as wide, the second segment more than twice as long as wide, and the conical third segment nearly three times as long as wide. In all of the other genera the maxillary palpus resembles that of *C. bivulnerus* and the distal segment of each bears a group of peg-like organs, tactile setae.

The galea (Fig. 18, *ga*) in *C. bivulnerus* is the broad triangular area distad of the palpifer. Its shape and structure is more or less constant throughout the family, the most notable exception being found in Hyperaspis (Fig. 27, *ga*). In this genus the galea is rounded and appears to be more or less sponge-like and bears a few setae. In Epilachna (Fig. 16, *ga*) the distal margin of the galea is densely setaceous, while in all of the other genera of the family it bears only a few setae. There is a peg-like structure on the galea that bears a striking resemblance to the distagalea; this is nothing more than a tactile seta and cannot be interpreted as a distagalea.

The mesal margins of the maxillae and the lateral margins of the labium are connected in all of the genera by a distinct membrane, the labiacoria (Fig. 18, *lic*). The lateral margins of the maxillae and the mandibles are connected by a similar membrane, the maxacoria (Fig. 18, *mxc*). An extension of the maxacoria connects the stipes and cardo of each side to a postgena.

The labium of coccinellid larvae differs considerably from that found in the more primitive forms, as the larvae of Corydalis and the adults of Periplaneta. Many of the parts seem to be lacking. The type of labium found in the more generalized coleopterous larvae shows but little resemblance to the coccinellid labium. By a study of the labia of the primitive forms named and of the more generalized Coleoptera, one is able to homologize the parts.

The labium of *C. bivulnerus* is the more or less membraneous area cephalad and ventrad of the gula and between the maxillae. It appears to be made up of two parts, the submentum (Fig. 18, *su*) and the ligula (Fig. 18, *lig.*). The mentum is indistinguishable or fused with the ligula. The submentum (Fig. 18, *su*) is the large proximal portion. It is membraneous, more or less rectangular, usually with four setae, two large ones which decussate, and two smaller ones. In Anatis, Megilla, Coccinella, and Hippodamia there may be many setae on the submentum, the number varying from four in *Hippodamia convergens* to eighteen in Anatis. The submentum is not clearly or distinctly separated from the ligula in *C. bivulnerus* but there is a distinct division between the two in Epilachna (Fig. 16), while in Hyperaspis (Fig. 27) the division between the ligula and submentum is entirely obsolete. In all of the other genera studied the condition of this division approximates that found in Chilocorus. The

ligula is the distal portion of the labium. In *C. bivulnerus* it is composed of the fused stipulae, glossae, and paraglossae. Near the ventro-lateral margin there is a distinct shoulder-like swelling, the palpiger (Fig. 18, *pg*), which bears a two-segmented labial palpus (Fig. 18, *lipl*). There is a heavy, semicircular, chitinous band (Fig. 18, *cb*) that surrounds each palpiger which probably serves to increase its rigidity. Each labial palpus consists of two segments. The proximal segment is short, as wide as long; while the distal segment is conical and bears a group of tactile setae at its distal end. The ligula also bears four to six moderately large setae. The type of ligula found in *C. bivulnerus* is remarkably constant within the family, the only notable variation being found in Hyperaspis, where the labial palpi have been reduced to a single dome-like segment which bears a few tactile setae (Fig. 27, *lipl*).

THORAX

That part of the body caudad of the head consists of thirteen segments. The dorsal surface of the segments is convex and the ventral surface concave or flattened. They may be provided with scoli, senti, parascoli, strumae, verrucae, or chalazae and setae. The variation in the type of armature will be taken up later. The first three segments constitute the thorax and the remainder the abdomen. In all of the genera of the family the thoracic segments are distinctly separated from each other by a deep coria, more distinct on the ventral than on dorsal surfaces.

Prothorax

The prothorax of *C. bivulnerus* (Figs. 1, 2 and 3, *prth*) is about two-thirds as long as the mesothorax and metathorax combined. The same is true of Epilachna, Microweisea, Scymnus, and Hyperaspis; while in all of the genera of the Coccinellini the prothorax is about one-half as long as the other thoracic segments together.

The tergum is usually convex and oval in outline when viewed from above (Figs. 1 and 2, *t*). In *C. bivulnerus* the greater part of the dorsum is covered with a dark heavily chitinized dorsal shield from which the cone-like senti project. This shield is formed by the fusion of pinacula and its surface bears numerous fine setae. The dorsal shield, when viewed from above, appears to be rectangular in outline and is divided into two parts by a slender white line extending along the dorso-meson. The senti are arranged in three distinct groups, a cephalic group of six placed in a transverse row near the cephalic margin, a lateral group of one placed near the middle of each lateral margin, and a caudal group of one placed near the middle of each half upon the caudal margin. In Epilachna the dorsal shield does not cover such a large portion of the dorsum. It is more or less oval in outline and bears only the cephalic row of four scoli. Its sur-

face is also covered with short fine setae. In all of the genera of the Coccinellini the dorsal shield is large and covers the greater part of the dorsal aspect. It is not so heavily chitinized as in Chilocorus and is divided longitudinally into four plates. Two of these are adjacent on the dorsomeson and each bears three or more large chalazae and many small setae. The lateral plates are smaller than the mesal and bear a fringe of large chalazae on their lateral and cephalic margins. In Microweisea and Scymnus the dorsal shield is only indicated and very slightly chitinized. It appears to extend over the larger part of the dorsum and bears several large black setae. These are arranged in three transverse rows, a row on the cephalic and caudal margins and another midway between them. In Hyperaspis the dorsal shield is wanting and the tergum is only slightly chitinized. It is traversed by three rows of prominent black setae arranged as in Scymnus and Microweisea. There are in addition to these larger setae, many smaller and inconspicuous ones.

The pleural area in *C. bivulnerus* is the more or less reduced area ventrad of the dorsal shield (Fig. 2, *prpl*). It extends ventrad to the sternal area. There is a small group of setae cephalo-dorsad of the procoxacoila in most of the genera studied. This is the only group of setae located on the lateral aspect of the prothorax.

The prosternum of Chilocorus is the rectangular area located between the coxal fossae. There has been much controversy among morphologists as to the number of sclerites in this area. It is not my purpose to discuss this question, there are, however, a few landmarks of this region that must be considered. In all of the species studied there is a small pit, the furcina, (Fig. 3, *fur*) found near the meso-caudal boundary of each procoxacoria. There is a distinct ridge extending between these pits which probably serves as a place for the attachment of muscles. The prosternum of Chilocorus, Epilachna, Microweisea and Hyperaspis usually bears a few small setae and chalazae just cephalad of the procoxacoria, while in all of the genera of the Coccinellini it bears two distinct verrucae which are located adjacent to the meson.

Mesothorax and Metathorax

In general the mesothorax and metathorax of coccinellid larvae are so nearly similar that a single description will suffice for both of them. Each of these segments is wider than long, but in other respects they are similar to the prothorax in form.

The mesotergum in *C. bivulnerus* (Fig. 1, *mst*) is distinctly longer and narrower than the metatergum (Fig. 1, *mtt*). In practically all of the genera of the Coccinellini the mesotergum and metatergum are subequal in length, but the metatergum is as a rule wider than the mesotergum. In Microweisea, Scymnus, and Hyperaspis the mesotergum is longer and

narrower than the metatergum. The mesotergum and metatergum of *C. bivulnerus* do not bear dorsal shields. Each tergum bears a transverse row of four senti, the pinacula of which are distinct and never fused. The median senti are much smaller than the lateral ones. In Epilachna there is a small median dorsal shield from which two scoli project, these scoli originate so close together that they seem to be the two forks of a single scolus. In all of the genera of the Coccinellini the dorsal shield is present on the mesotergum and metatergum as a raised oval area which covers the larger part of the dorsum. The mesal margin of this shield bears a pair of small parascoli, while the lateral margin bears a large parascolus. The surface of the shield is densely covered with fine setae and in the genera Coccinella, Hippodamia, and Anatis also bears chalazae. In Scymnus and Microweisea the dorsal shield is weakly chitinized, covers the larger part of the dorsum, and bears a small verruca on each side of the meson. Hyperaspis, on the other hand, has no dorsal shield nor is there any chitinization to suggest the presence of a shield. The terga bear many long, black, prominent setae which are arranged in more or less transverse rows; one row on the cephalic and one on the caudal annulet of each segment.

The pleural areas of the mesothorax and metathorax of all of the species studied are well developed. They are the lateral vertical areas between the terga and the sterna (Fig. 2, *mspl*, *mtpl*). In *C. bivulnerus* the mesopleural area is much larger than the metapleural; this is also the case in Microweisea, Scymnus, and Hyperaspis. In Epilachna the metapleural area is larger than the mesopleural; while in all of the genera of the Coccinellini they are subequal. The ventral portions of the mesopleural and metapleural areas are obliquely crossed by a furrow extending caudomesad from the coxacoila. In *C. bivulnerus* the mesopleural area bears two subequal senti, one near the cephalic and one near the caudal margin; the base of each of these senti is provided with a small pinaculum. The metapleural area bears two senti, but the cephalic one is much smaller than the caudal. In Epilachna the cephalic area bears a few small setae, while the caudal one bears the large scolus. In the Coccinellini the cephalic area usually bears a few small setae, and the caudal one is provided with a parascolus in Hippodamia, Coccinella, and Anatis; while in Megilla and Adalia this area bears a struma. In Microweisea, Scymnus, and Hyperaspis the cephalic area is smaller than the caudal area which bears a small verruca in the two former, and a few fine setae in the latter.

The mesosternum and metasternum are so nearly similar to the prosternum that no description is necessary.

In *C. bivulnerus* the mesothoracic spiracle is located in the small triangular area lying between the mesotergum and the mesopleural area, the protopleurite (Böving 1917). This condition is also found in all of the

members of the Coccinellini and Epilachna; while in Microweisea, Scymnus, and Hyperaspis the mesothoracic spiracle is not located on the tergum, or protopleurite, as Böving points out, but distinctly in the mesocoria. The metathoracic spiracles are rudimentary or entirely wanting.

Appendages

The thorax of all coccinellid larvae bears three pairs of legs. One pair is attached to each segment. They are well developed and fitted for walking or clasping the surface of the leaves and stalks upon which the larvae are usually found. Since the general form and structure of each pair of legs is the same, their only difference being that of size, a description of a single prothoracic leg will suffice for all. The mesothoracic and metathoracic legs are subequal and slightly longer and wider than the prothoracic legs. Each leg is about as long as the body is wide, except in very young larvae in which they are distinctly longer. In adult larvae they are comparatively stout and fitted for clasping. The coxal fossae are the circular or oval holes in the sternum in which the legs are inserted. The coxa are attached to the coxal fossae by a distinct membrane, the coxacoria. There is a distinct coxacoila on the lateral margin of each coxal fossa in which the coxa articulates. The procoxa (Figs. 2 and 3, *prc*) is subcylindrical, short, tapering toward the distal end and bears a few scattered but prominent setae. The protrochanter (Figs. 2, 3, *prtr*) is short, triangular, the ventral surface the longer and bears a prominent group of coarse setae. The profemur (Fig. 3, *prfr*) is short, about twice as long as wide, with its dorsal, caudal, and cephalic surfaces sparsely setaceous. This condition of the femur is found in Chilocorus and Hyperaspis; while in Epilachna and all of the genera of the Coccinellini, and the genera Microweisea, and Scymnus, the femur is at least three times as long as wide. The protibia (Figs. 2, 3, *prti*) is about as long as the profemur, one-third as wide as long, and tapering distinctly toward the distal end. The cephalic, caudal, and dorsal surfaces of the proximal two-thirds are densely setaceous; while the entire surface of the distal one-third is densely covered with club-shaped setae or tenent hairs (Fig. 43, *te*). The tenent hairs are very numerous in Chilocorus, Epilachna, and all of the genera of the Coccinellini; while in Scymnus and Hyperaspis there are only a few, five to ten, on each tibia, and in Microweisea there are only two which are very broad, flat, elongated, and paddle-like (Figs. 44, 45). The protarsus (Figs. 2, 3, *prta*) consists of a single short triangular segment which bears a few tenent hairs. Its distal margin is provided with a sickle-shaped claw (Figs. 4, 3, *prcl*). This claw is provided with a short, blunt appendiculated tooth on its proximo-ventral angle, and it probably serves as an aid in clasping surfaces. There is some variation in the general shape of the tarsal claw in the various genera of the family and this characteristic serves as a means of separating them.

ABDOMEN

The abdomen of all coccinellid larvae is composed of ten segments which are connected by more or less distinct coria. This coria is usually more prominent on the ventral than on the dorsal aspect. The abdomen is generally subdepressed, widest on its cephalic half, and tapering on its caudal half. The abdomen in *C. bivulnerus* narrows gradually toward the caudal end. The first three segments are about as wide as the metathorax. This is also true of Epilachna and of all of the genera of Coccinellini in which the first, second, third, and fourth abdominal segments are subequal in width. The remaining abdominal segments become narrower toward the caudal end. In Microweisea and Scymnus the first, second, and third abdominal segments are the widest; caudad of the third the abdomen becomes narrower. In Hyperaspis the first, second, fifth, and sixth segments are subequal in width; while the third and fourth are the widest segments in the body.

In *C. bivulnerus* the first abdominal segment is slightly narrower and shorter than the metathorax. Its tergum (Figs. 1, 2) bears four distinct senti arranged in a transverse row. The dorsal senti are adjacent on the dorso-meson and the dorso-lateral ones are placed on each side near the lateral margin of the tergum. There is a small circular pinaculum at the base of each sentus. The dorsal pinacula are brown or yellow colored and the dorso-lateral ones are white. There is also a few inconspicuous setae on the surface of each pinaculum. The lateral aspect is a vertical area, almost square, and bears the large lateral sentus, at the base of which there is a very large pinaculum nearly covering the entire surface. The paralateral group is wanting. The sternum (Fig. 3, *st*) is about as long as the tergum. The coria between it and the metatergum is not at all distinct. The cuticle is thin and membraneous and bears two groups of small ventral setae adjacent to the ventro-meson. The ventro-lateral setae are wanting.

The external structure of segments two to five inclusive is similar, however, each succeeding segment is narrower than the preceding one. The coriae between the segments are distinct. Each tergum has four senti arranged in a transverse row. The dorsal senti and their pinacula are adjacent to the dorso-meson; the dorso-lateral senti are located in a position similar to those of the first abdominal segment. All of the pinacula are dark brown in color and bear numerous fine setae. Each lateral aspect is almost square and bears a distinct lateral sentus. The pinacula at the base of these senti are small. In the second and third segments ventrad of the lateral senti there is a solitary small seta; while in segments four and five there is a prominent chalaza surrounded by a group of small setae. This group represents the paralaterals. Each sternum is as long as its respective tergum and the coriae between the sterna are distinct. The cuticle is thin and membraneous and bears on each sternum four groups

of chalazae arranged in a transverse row; those near the meson are the ventral chalazae and those on the lateral margin are the ventro-laterals. Each chalaza is surrounded by a small group of setae.

The sixth, seventh, and eighth abdominal segments are as long as the preceeding but narrower. The pinacula at the bases of the dorsal senti have become fused on their mesal margins and appear to be dumb-bell-shaped. The dorso-lateral senti are shorter than those of the preceding segments and their pinacula are very much reduced. The lateral aspect of each of these segments is similar to that of the preceding, except that it is considerable smaller. There is a small lateral sentus with a very small pinaculum on the lateral aspect of the sixth and seventh segments and almost a rudimentary sentus on the eighth segment which is without a pinaculum. In Epilachna the lateral aspect of the seventh segment is provided with a distinct parascolus rather than with a scolus as in the sixth; while the eighth segment has a struma and the ninth only a few chalazae. There is a distinct chalaza surrounded by a group of fine setae ventrad of the lateral sentus of each segment. This chalaza and the setae represent a paralateral group. Each sternum is as wide and as long as its respective tergum. The cuticle of each segment is soft and bears four distinct chalazae arranged in a transverse row. Each chalaza is surrounded by a group of small setae. The ventral groups are adjacent to the ventro-meson and the ventro-lateral groups are located near the extreme lateral margin of each segment. The coriae between the segments are distinct.

The ninth abdominal segment is small, cylindrical, slightly narrower and shorter than the eighth. The tergum is inclined ventrad at an angle of about thirty degrees. The dorsal senti are absent and in their place there are distinct dorsal strumae. The dorso-lateral senti are also reduced to strumae and located near the lateral margin of the tergum. The lateral aspect is small and the senti are wanting, but there is a prominent chalaza surrounded by a group of setae near the ventral margin. This group represents the lateral group; the paralaterals are wanting. The ninth sternum is short, deeply emarginated on the caudal margin, and bears four chalazae arranged in a transverse row. The ventral chalazae are located adjacent to each other and the ventro-meson and are surrounded by a group of fine setae; while the ventro-lateral are without setae. Throughout the family the ninth segment shows the greatest variation in its size, shape, and structure. In Chilocorus the ninth abdominal segment is rectangular, about twice as wide as long; its anterior margin is little if any narrower than the eighth segment; the caudal margin is sharply rounded and never serrated; and its lateral aspect bears chalazae and setae. The lateral aspect of the ninth segment in Epilachna is rectangular, about twice as wide as long, much narrower than that of the eighth segment, and

with the caudal margin broadly rounded. Each lateral aspect bears a small chalaza. In all of the genera of the Coccinellini the ninth segment is more or less rectangular. The caudal margin is broadly rounded, usually widest near the middle, distinctly narrower than the eighth segment, and never crenulate or serrate. The lateral aspect is provided with numerous setae. In Microweisea the ninth segment is conical, about twice as long as wide, and much narrower than the eighth. The distal margins are sharply rounded and the tergum is chitinized and brown. The lateral aspect is provided with a few fine setae. In Scymnus the ninth segment is conical, about one-half as wide as long, much narrower than the eighth and not heavily chitinized. In Hyperaspis the ninth segment is semicircular, about twice as wide as long, and narrower than the eighth. The caudal margin is broadly rounded and never crenulate or serrate. The lateral aspect bears a few fine setae.

The tenth abdominal segment is as a rule not visible from the dorsal aspect. It appears to be a small ring of thin membrane surrounding the rosetted anal area. In the Coccinellini this membrane is often pigmented and appears black or brown colored. The rosetted appearance of the anal area is caused by the evagination of the rectum. This serves as a sucking disk and aids the larvae in locomotion.

In all the coccinellid larvae there are eight pairs of abdominal spiracles (Figs. 1 and 2, *abdsp*), a pair situated on each abdominal segment from one to eight inclusive. They are located near the cephalic margin of each tergum between the dorso-lateral and lateral senti in Chilocorus and Anatis, between the dorso-lateral and lateral scoli in Epilachna, between the dorso-lateral and lateral parascoli, strumae or verrucae in Hippodamia, Coccinella, Megilla, Adalia, and Scymnus, and between the dorso-lateral and lateral chalazae or setae in Hyperaspis.

There is a pair of repugnatorial pores on segments one to eight (Figs. 1, 2, *rp*). These pores are located on each lateral margin of the tergum in the coria between the segments. They emit a bad smelling fluid which is of a repulsive nature and serves to protect the larva from its enemies.

On each side of the dorso-meson in segments one to eight there are two small pits. There is another pair on each side of the tergum near the middle about midway between the dorsal and dorso-lateral senti of segments one to nine. All of these pits are arranged in a transverse row on the tergum. There is another pit on the lateral aspect of segments one to nine which is located immediately ventrad of the ventral senti. These pits are probably the points of attachment for muscles.

ARMATURE OF THE BODY-WALL

The armature of coccinellid larvae consists of spine-like setae on the body-wall or of conical, finger-like, or mound-like projections of the body-

wall which bear setae. They are known as scoli, senti, parascoli, strumae, verrucae, chalazae, or setae and vary greatly in form in the different tribes and genera of the family. After a study of the larvae of the Chrysomelidae, the probable progenitors of the Coccinellidae, one becomes convinced that Chelymorpha shows perhaps the greatest resemblance to the generalized coccinellids. In Chelymorpha each lateral margin of the body is provided with a longitudinal row of long branched projections of the body-wall. The distal end of each of these branches bears a stout seta. Fracker in his work on lepidopterous larvae called structures similar to these *scoli*. It was unfortunate, however, when he applied the same term to a non-branched projection of the body-wall which bears setae upon its trunk. These two structures are so widely different that they cannot be considered as one and the same thing and for the latter the name *sentus* is proposed. Fracker has also shown that the arrangement and number of setae on the prothorax represents the generalized condition in lepidopterous larvae. This may be true in coccinellid larvae, but there has been no attempt made in this work to homologize the setae or the projections that bear them. Since the arrangement of the setae in the various genera differs, especially on the abdominal segments, this character has been used to some extent in separating genera, and it is, therefore, necessary to adapt a tentative nomenclature for these structures. This nomenclature is based upon the conditions found in the third abdominal segment and has been applied only to the segments of the abdomen.

There is a seta or a projection bearing a seta or setae on each side of the dorso-meson. These are designated as the dorsal group. The projection on each lateral margin of the tergum is a dorso-lateral group, the one on the dorsal portion of the lateral aspect is a lateral group, the one on the ventral margin of the lateral aspect is the paralateral group, the small group on each lateral margin of the sternum is a ventro-lateral group, and the one on each side of the ventro-meson is the ventral group.

The scolus is a branched projection of the body-wall, usually more than five times as long as wide (Fig. 28). Each branch of the scolus bears at its distal end a single stout seta. The dorsal and lateral surfaces of the thorax and abdomen of Epilachna are provided with distinct scoli.

The parascolus is a modification of the scolus in which the projection is not more than three times as long as wide and usually not more than twice (Fig. 30). This structure bears a few short branches which are about as wide as long, each with a seta at its distal end. This modified scolus is designated as a parascolus. It is found in Hippodamia, Coccinella, and on the caudal segments of Anatis.

A sentus is an elongated, cone-like projection of the body-wall which is not branched like a scolus, but bears a few short stout setae upon its trunk (Fig. 29). Fracker called this a scolus, but it differs decidedly in

form from the true scolus and has been called a sentus. Senti are found in Chilocorous and Anatis. In the latter genus the senti are short and thick.

A pinaculum is the more or less chitinized plate which surrounds the base of a scolus, sentus, or parascolus (Figs. 28, 29, 30). It usually bears numerous, small, dark-colored setae. Several pinacula may become fused to form the shield-like plates of the body.

A chalaza is a distinct but slight pimple-like projection of the body-wall. It may be considerably wider than long and bears on its distal end a stout seta (Fig. 33). Chalazae are present in practically all coccinellid larvae. They are for the most part found on the sternum and in some cases on the lateral aspect. In Microweisea distinct chalazae are found on the dorsal aspect of the abdomen, there are also distinct chalazae on the dorsal shield in most of the genera of the family.

A struma is a parascolus which has become shortened, usually appearing to be nothing more than a distinct mound-like projection of the body-wall (Fig. 31) upon which are situated a few chalazae. This structure was formerly called a tubercule, but this term is misleading and has been applied by various workers to most any kind of an extension of the body-wall. In order to avoid further confusion the term struma is proposed for this structure. Strumae are found in the armature of the abdomen of Adalia and Megilla.

The struma becomes much reduced in some of the more specialized larvae so that it appears to be mound-like and bears setae instead of chalazae (Fig. 32). This structure has also been called a tubercule by some workers and by others a verruca. Since the term verruca is not misleading or conflicting, it should be restricted to structures such as these. Verrucae are found in the armature of Scymnus and very small indistinct ones in Microweisea; the latter genus also bears chalazae.

In the most specialized of the coccinellids verrucae and chalazae have become so greatly reduced that the setae are not elevated above the general surface of the body (Fig. 34). Setae are found on the body of all of the more generalized coccinellids, but it is only in the more specialized groups that the setae constitute the only type of armature. The Hyperaspini is the only tribe that I have studied which has this condition.

In the more generalized genera the armature of the body consists of scoli arranged upon the dorsal and lateral surfaces. Such a condition as this is found in the subfamily Epilachninae. In Chilocorous and Anatis the scoli are replaced by senti on the dorsal and lateral aspects and on these regions in Hippodamia, Coccinella, and to a small extent in Adalia parascoli are present. The projections of Adalia seem to show a stage of transformation between parascoli and strumae; for parascoli are found on the dorsal surface and strumae on the lateral. Strumae are found on the

dorsal and lateral regions of Megilla, but on the lateral aspect of the eighth segment there is a verruca. Verrucae are found almost exclusively on Scymnus, while in Microweisea they are very small and closely approximate the form of chalazae. Verrucae are also found on the ventral portion of the ninth segment in practically all genera of the Coccinellidae, the only exceptions being Hyperaspis and Scymnus. Chalazae are found on the dorsal shield and on the shield-like spots of the mesothorax and metathorax of Hippodamia, Megilla, Anatis, Adalia, and Coccinella. There are also a few on the prothoracic shield of Scymnus. The same type of armature is present on the ventral parts of the thoracic and abdominal segments throughout the family and on the lateral portions of the eighth and ninth segments of Adalia, Megilla, and Scymnus. They are usually surrounded by a group of finer setae. In Hyperaspis and its allies the armature of the body has been so reduced that it is composed of setae forming a hair-like covering over the entire surface. The ventral surface of all of the members of the family is provided with setae rather than scoli, parascoli, senti or strumae. Even in those genera where chalazae or verrucae are found on the ventral surface, setae are also abundant. The type of armature of the Coccinellidae shows a steady and unbroken series of changes in specialization from the generalized scolus to a seta through the reduction or the disappearance of parts.

SYNOPSIS OF LARVAE

In the taxonomic study of any group of organisms, the investigator should not draw conclusions from characteristics which upon the surface may show a high degree of specialization or generalization, without first making a careful study of these characteristics, no matter how important or unimportant they may seem. According to Comstock, "The logical way to go to work to determine the affinities of the members of a group of organisms is first to endeavor to ascertain the structure of the primitive members of this group; and then endeavor to ascertain in what ways these primitive forms have been modified by natural selection." With such a view as this in mind, the taxonomist must not only study the members of the group upon which he is working, but he must also endeavor to ascertain the conditions that existed in the progenitors of the group. It is obvious, then, that those conditions in the chosen group which are most nearly similar to the conditions in their progenitors are the most generalized; further, that those individuals possessing these primitive characteristics are the generalized individuals of the group. There are often two or more sets of prominent characters, and many times these may not run in parallel lines, but seem to contradict each other or to run in opposite directions. For instance in the larvae of the Coccinellidae that form which shows the most generalized condition of the head sutures, the Epilachninae, have also what seems to be the most highly specialized condition of the setae or scoli on the body; and Hyperaspini which have the most highly specialized condition of the head sutures show what appears to be the most generalized condition of the setae.

If one studies the conditions present in the Chrysomelidae, the probable progenitors of the Coccinellidae, he will find in the genus Chelymorpha conditions of the epicranial suture and scoli similar to those found in the Epilachnini. The epicranial stem in Chelymorpha is long and the epicranial arms are gradually divergent, a condition almost identical with that of the Epilachninae. The members of the subfamily Coccinellinae have a much shorter epicranial stem or in many genera it may be entirely wanting and the epicranial arms diverge immediately from the occipital foramen. Even the epicranial arms are wanting in the adult larvae of Scymnus and Hyperaspini; while the clypeal suture, which is distinct and entire in Chelymorpha and Epilachna, is incomplete and only indicated

on each margin of the head in the Coccinellinae. This fact tends to show a complete reduction of the sutures which are distinct in Epilachna and are entirely wanting or only slightly indicated in the Hyperaspini.

The condition of the armature of the body also shows a like reduction. In both Epilachna and Chelymorpha scoli are present. In Chilocorus the scoli are replaced by senti and in those forms which show a further reduction of the epicranial arms we find that there is a further reduction in the armature of the body. In Hippodamia, Coccinella, Adalia, Anatis, and Microweisea, forms in which the epicranial arms alone are present, the armature consists of parascoli, strumae, verrucae, and chalazae or setae; while in the Hyperaspini in which the epicranial suture is wanting the body is provided only with setae. The condition of the scoli in Epilachna might easily be taken as a highly specialized characteristic, but when one studies the characteristics of the progenitors of the Coccinellidae, he finds such a condition in the armature of the body as is found in the Epilachninae. There is a further likeness between the Chrysomelidae and the Epilachninae that seems also to be of importance, that is the food habits of the two are almost identical, as both are phytophagous. The Epilachninae are perhaps the only group of coccinellids that are entirely phytophagous in both the larval and adult stages.

The fact that the setae in Hyperaspini show an apparently generalized condition, while the epicranial suture is absent in the adult larval stages and present in the first larval stages, surely a specialized condition, does not interfere with this proposed classification. For specialization, as Comstock has pointed out, may take place in two wholly different ways. "First, by the addition or complication of parts, specialization by addition; second, by the reduction in the number or the complexity of the parts, specialization by reduction." The latter is considered to be the case in the Hyperaspini; the primitive scoli have been reduced to setae. Granting this to be true, we can readily see that these two wholly different characteristics, the condition of the scoli and the epicranial suture, show in a very striking way the presence of specialization in Hyperaspini and of generalization in the Epilachninae. In the first case there is the absence of the epicranial stem, only an indication of the clypeal suture, and a reduction of the scoli to setae; while in the latter there is the presence of the epicranial and clypeal sutures and of scoli similar in form to those of Chelymorpha.

Since, as Comstock has shown, there is such a thing as specialization by reduction and since the progenitors of the coccinellids, as nearly as we can ascertain, have an epicranial and a clypeal suture and a well-developed system of scoli, it seems to me altogether logical, and with the evidence at hand quite clear that the Epilachninae represent a generalized type of coccinellid larvae, though at a first glance they may appear to be highly specialized.

There is a great variation in the general structure of the larvae of the Coccinellidae. This variation ranges from the phytophagous type found in Epilachna to the extreme carnivorous type found in Scymnus and Hyperaspis. The larvae of the family possessing the phytophagous type of structure can very easily be mistaken for certain chrysomelid larvae which they resemble in general shape and in the arrangement of their scoli and pinacula, while those of the more carnivorous types might at first glance be mistaken for chrysopid larvae. The coccinellid larvae may be distinguished from this latter group by the development of the mandibles which are not so prominent in the coccinellids. The mandibles of all of the carnivorous coccinellids differ from those of the Chrysomelidae in that they are not so broad and have a smaller number of dentes; while in Epilachna they resemble very closely the chrysomelid mandibles. All of the coccinellid larvae examined possess three ocelli on the lateral portions of the head, while the chrysomelid larvae may possess from one to six or none on each side.

The Epilachninae are undoubtedly the most primitive type of coccinellid larvae, a fact which is shown by their likeness to their chrysomelid progenitors. Among the carnivorous coccinellids, Chilocorus is the most primitive, while Hyperaspis, which is the farthest removed from the chrysomelid larvae, shows the most specialized condition.

SUBFAMILIES OF COCCINELLIDAE

Epicranial suture present, epicranial stem extending one-half the distance from the occipital foramen to a line drawn through the antacoriae; clypeal suture present; antennae slender, more than three times as long as wide; body with scoli.....*Epilachninae*

Epicranial suture present or wanting, when present, the epicranial stem never extending one-half the distance from the occipital foramen to a line drawn through the antacoriae; clypeal suture never complete, only indicated on each side; antennae short, never more than twice as long as wide; body without scoli.....*Coccinellinae*

EPILACHNINAE

The body is elongate, oval to fusiform. The dorsal and lateral aspects are armed with scoli, the sternum with strumae or chalazae, and the head with a few long setae. The epicranial stem and epicranial arms are always present; the clypeal suture is entire and distinct. The antennae are more than three times as long as wide, inserted more than their own length dorso-mesad of the precoila. Each mandible is heavily chitinized, its mola not well developed, and the distal portion with several dentes of various lengths, the distal dentes the longest.

This subfamily is represented in North America by a single tribe, the Epilachnini. Casey says, "This tribe is represented in the United States

by two or three large pubescent species belonging to the single genus Epilachna." One species occurs in small numbers in southern Illinois. The Epilachninae are truly phytophagous. Our common species feeds almost entirely upon the squash plant and its relatives. The beetle is commonly called the squash lady-bug. This subfamily is represented in the material studied by a single species of the genus Epilachna Chevrolat.

Epilachna borealis Fab.—The prothorax is slightly chitinized with a transverse row of four scoli on the dorsum near its cephalic margin and a transverse row of small setae on its caudal margin; the pleural area is small and glabrous; the prosternum is short with two distinct setae on the ventro-meson; and the procoxacoriae are distant. The mesothorax and metathorax are subequal in length and width, the dorsum of each with four scoli, two on each side of the meson arising from the same pinaculum; the mesothoracic spiracles are located in the mesocoria; the metathoracic spiracles are wanting; the caudal portion of the mesothoracic and metathoracic pleural areas are each provided with a large prominent scolus; the mesothoracic and metathoracic sterna are each provided with a group of setae on each side of the ventro-meson; and the mesocoxacoriae and metacoxacoriae are distant. The coxa is short and subcylindrical; the trochanter is triangular, about as long as the coxa and bears a few setae; the femur is as wide as the trochanter, about twice as long and covered with numerous small stiff setae; the tibia is about as long as the femur and about two-thirds as wide, its dorsal and lateral surfaces are covered with short stiff setae, its ventral surface is thickly covered with fine setae, and the distal one-third is covered with tenent hairs; and the tarsus consists of a single segment which bears the heavily chitinized hooked claw and a few tenent hairs. The terga of the abdominal segments one to eight inclusive are similar. Each tergum is provided with four scoli, the dorsal scoli are adjacent to each other and the meson and the dorso-lateral scoli are on the lateral margins of the tergum. The ninth tergum bears four strumae which represent the dorsal and dorso-lateral groups; the tenth segment is membraneous. Each lateral aspect of segments one to six is provided with a prominent lateral scolus, of segments seven and eight with a lateral struma, and of segment nine with a lateral verruca. The paralateral group is represented by a prominent chalaza surrounded by a group of small setae ventrad of each lateral scolus. Sternum one is provided with two prominent ventral chalazae, the ventro-laterals are wanting; sterna two to nine bear two adjacent ventral chalazae and two ventrolateral chalazae located near the lateral portion of each sternum; and sternum ten is crescent-shaped and armed with setae. The rectum is evaginated to form a disk-like sucker. It is used as an aid in locomotion.

COCCINELLINAE

The body is elongate to oval, dorsal surface convex, ventral surface concave or flat. The body-wall is provided with senti, strumae, verrucae, chalazae, or evenly distributed setae. The head is provided with long distinct setae. The epicranial stem and epicranial arms may be present or wanting, when present, the epicranial stem never extends more than one-third of the distance from the occipital foramen to a line drawn through the antacoriae. The clypeal suture is never entire, but is usually indicated by a distinct furrow which extends mesad on each side from the precoila. The antennae are never more than three times as long as wide, consist of three segments, and are inserted about midway between the ocelli and the precoilae. The mandibles usually have one, two, or three teeth at the distal end, and the proximo-mesal margin is provided with a triangular or mound-shaped mola.

This subfamily includes all of those tribes the members of which are carnivorous. They may also be phytophagous to the extent that they may eat fungi and probably small amounts of pollen.

Tribes of Coccinellinae

1(6) Epicranial arms always present; epicranial stem always present in all larval stages unless obliterated by the separation of the epicranial arms.....2

2(3) The dorsum of the body armed with senti six to eight times as long as wide; the epicranial stem extending one-third of the distance from the occipital foramen to a line drawn through the antacoriae; epicranial arms gradually divergent.....*Chilocorini*

3(2) The dorsum of the body never armed with senti six to eight times as long as wide.....4

4(5) Dorsum of the body armed with short senti, parascoli, or strumae; epicranial stem, when present, never extending one-third the distance from the occipital foramen to a line drawn through the antacoriae; epicranial arms gradually or abruptly divergent .....*Coccinellini*

5(4) Dorsum of the body provided with small verrucae or setae; epicranial stem always obliterated by the separation of the epicranial arms, epicranial arms diverge from the occipital foramen .....*Microweiseini*

6(1) Epicranial stem and epicranial arms never present in adult larvae 7

7(8) The dorsal and lateral aspects of the body with strumae or verrucae.....*Scymnini*

8(7) The dorsal and lateral aspects of the body with fine slender setae .....*Hyperaspini*

Chilocorini

The body is subovate, widest at the metathorax. The first three abdominal segments are slightly narrower than the metathorax, segments four to eight are successively narrower, segment nine is about as wide as long, its caudal margin is broadly rounded and its lateral margin is provided with a distinct struma; and segment ten is small and directed ventrad. The dorsal and lateral aspects of the body are provided with long senti the length of which varies on the different portions. The epicranial stem and epicranial arms are present. The epicranial stem extends about one-third of the distance from the occipital foramen to a line drawn through the antacoriae, divides and forms the two epicranial arms which diverge gradually for a short distance, then widely, and finally each extends laterad to a point dorsad of an antacoria and ventrad of an ocellus where it becomes obsolete. The mandibles are triangular in outline, heavily chitinized, the apex is bifurcated, and the proximo-mesal margin is provided with a distinct mola.

This tribe is represented in the material studied by the single genus Chilocorus Leach.

Chilocorus bivulnerus Muls.—The head is chitinized, dark, and provided with numerous setae. The epicranial stem and epicranial arms are distinct; the clypeal suture is indicated on each lateral margin of the head. The mouth is directed cephalo-ventrad. The prothorax is provided with a large dark colored dorsal shield bearing ten senti, six of which are arranged in a transverse row near the cephalic margin. The lateral aspect of the prothorax bears a small group of setae cephalo-dorsad of the procoxacoria. The cephalic portion of the prosternum also bears a small group of setae on each side of the meson. The procoxacoriae are distant. The mesotergum is distinctly longer and narrower than the metatergum. Each is provided with four large senti arranged in a transverse row; the dorsal senti are distinctly smaller than the lateral ones. The pinacula are small and bear distinct setae. The mesopleural area is longer than the metapleural; both areas are obliquely crossed by a distinct furrow. The cephalic portions of the mesopleural and metapleural areas are subequal in size, triangular, and each provided with a large sentus. The mesothoracic spiracle is located in the mesocoria near the cephalic margin of the mesothoracic sentus; the metathoracic spiracle is rudimentary or wanting. The caudal portions of the mesopleural and metapleural areas are unequal in size, that of the metapleural area is much larger than that of the mesopleural. The cephalic metapleural sentus is about one-half as long as the caudal one. The mesosternum and metasternum are similar in size and shape. The mesocoria is distinct while the metacoria is obscure. The cephalic portions of the mesosternum and metasternum are each provided with a chalaza on each side of the ventro-meson; these chalazae are sur-

rounded by groups of setae. The legs are about as long as the body is wide and the tibia is very densely setaceous.

The first abdominal segment is shorter than the metathorax and its tergum bears four senti arranged in a transverse row; the dorsal pinacula are yellow and the dorso-lateral ones are white; the lateral aspect is rectangular with a large lateral sentus the pinaculum of which covers the greater part of the lateral surface and the paralaterals are wanting. The sternum is about as long as the tergum, the ventral setae are adjacent on the ventro-meson while the ventro-laterals are wanting. Abdominal segments two to five are similar, narrower than the first; their terga are subequal in length, the dorsal and dorso-lateral senti of each segment are arranged in a transverse row, and each sentus is provided with a distinct pinaculum. The lateral aspect is nearly square; the lateral senti are larger than the dorso-lateral, their pinacula are small. Ventrad of the second and third lateral senti, there is a small paralateral seta and ventrad of the fourth and fifth lateral senti, there is a paraleteral group of setae surrounding a distinct paralateral chalaza on each segment. The sterna are as long as their respective terga, slightly chitinized, their coriae are distinct, and each bears four chalazae arranged in a transverse row, each chalaza surrounded by six or eight small setae. Segments six, seven, and eight are each narrower than the preceding ones. Their dorsal pinacula are fused and the dorso-lateral senti are shorter than the dorso-lateral senti of segments two to five. Their lateral aspects are smaller, but are similar in shape to those of the preceding segments, the lateral aspects of the sixth and seventh segments are provided with small lateral senti, while the lateral sentus of the eighth segment is much reduced and the pinaculum is absent. Ventrad of each lateral sentus, there is a paralateral chalaza surrounded by a group of setae. The sterna are as wide as the terga, their coriae are distinct, and the ventral and ventro-lateral groups of setae surrounding the chalazae are present. The ninth abdominal segment is about as wide and about as long as the eighth, cylindrical, and inclined ventrad. Its tergum is shield-shaped and has two distinct dorsal verrucae near the caudo-mesal margin, the dorso-lateral verrucae are wanting. Its lateral aspect is small, each with a distinct lateral verruca, ventrad of the verruca there is a distinct paralateral chalaza surrounded by a group of setae. Its sternum is short, deeply emarginated on the caudal margin, the ventral and ventro-lateral groups of chalazae are present, and the ventral chalazae are surrounded by a few setae while the ventro-laterals are represented by a single chalaza. The tenth segment is small, not visible from the dorsal aspect and the rectum is evaginated to form a disk-like sucker. There is a pair of repugnatorial pores located in the coriae of segments one to seven about one-half the distance between the dorsal and dorso-lateral senti.

Coccinellini

The body is fusiform or elongate, widest at the metathorax, usually highly colored with black, red, yellow, orange, or blue; never with senti except in Anatis in which the senti are short and thick, but never five times as long as wide, usually with parascoli or strumae. The abdomen becomes gradually narrower toward the caudal end. The ninth abdominal segment is about twice as long as wide, never wider than long as in Chilocorini or Hyperaspini, never with lateral parascoli or strumae as in Chilocorini, dorsum provided with a light colored, slightly chitinized shield bearing many setae or chalazae. The head is heavily chitinized, the epicranial stem, if present, never extends one-third the distance from the occipital foramen to a line drawn through the antacoriae; the epicranial arms are usually widely divergent. The mouth is directed cephalo-ventrad.

The members of this tribe are more numerous in Illinois than those of any of the other tribes. They are almost wholly carnivorous, their only plant food being either fungi or in some cases pollen grains.

Genera of Coccinellini

1(2) Epicranial stem and epicranial arms always present; terga one to eight with strumae usually bearing three distinct chalazae and densely covered with fine setae.....*Megilla*

2(1) Epicranial arms always present; epicranial stem obliterated by the separation of the epicranial arms.....3

3(4) Terga one to eight with senti, not five times as long as wide.*Anatis*

4(3) Terga one to eight without senti.....5

5(8) Terga one to eight with parascoli or strumae which bear more than five chalazae and are sparsely setaceous.....6

6(7) Tarsal claw with a distinct appendiculated tooth at its proximal end.....*Coccinella*

7(6) Tarsal claw without a distinct appendiculated tooth at its proximal end.....*Hippodamia*

8(5) Terga one to eight with strumae which never bear more than five prominent chalazae and the surface of the strumae densely setaceous.....*Adalia*

MEGILLA Mulsant

This genus is represented in the material studied by a single species.

Megilla maculata DeGeer.—The body is elongate, widest at the mesothorax and metathorax. Its general color is black and mottled with light yellow or cream-colored areas. The head is heavily chitinized, the dorsal portion dark and the ventral portion more or less white. The epicranial stem is present as a short line or suture on the dorsal portion of the head. It extends about one-fifth of the distance from the occipital foramen to a

line drawn through the antacoriae. The epicranial arms diverge laterad and ventrad and become obsolete slightly mesad of the antacoria. The mouth is directed ventrad. The cephalic margin of the prothoracic shield is provided with two small cream-colored spots, and the caudal margin with a yellow boundary. The mesothorax and metathorax have a shield-shaped cream-colored area on the dorso-meson; the cephalic portion of the mesothoracic and metathoracic lateral aspects are also cream-colored. There is a light colored area on the dorso-lateral portions of abdominal segments one to eight. On the lateral portion of the first segment, and on the tergum and lateral aspects of the fourth and fifth segments, the cuticle is yellow. The ventral aspect of the entire larvae is tan colored. The prothoracic shield is provided with many chalazae and numerous setae, the terga of the mesothorax and metathorax are provided with a large struma-like shield which bears six to eight chalazae. The lateral aspect of the prothorax is glabrous. The mesothoracic spiracles are situated in the mesocoria near the cephalic margin of the lateral aspect and each spiracle is surrounded by three or four small, black setae. The cephalic portion of the lateral aspect of the metathorax has three or four setae, but the metathoracic spiracles are wanting. The caudal portions of the mesothorax and metathorax are about twice as large as the cephalic and provided with a struma-like plate which bears six to eight chalazae. The sternum of all of the thoracic segments is provided with a small pair of verrucae adjacent the meson near the cephalic margin of the segment. Each tergum of segments one to eight is provided with a transverse row of four strumae, two dorsal and two dorso-laterals. Each struma usually bears three distinct chalazae. The lateral aspect of segments one to eight is each provided with a large lateral struma with four to eight chalazae, of segments two to eight with a small mound-like paralateral struma usually with one large chalaza and many seta on each segment. Each sternum of segments one to eight has a transverse row of four chalazae, each chalaza surrounded by a few setae. The ventro-lateral group is wanting on the first sternum. The tergum of the ninth segment is longer than wide, shield-shaped, its cephalic margin slightly emarginated, darkly colored and densely setaceous. The lateral aspect is much reduced and bears a single large lateral chalaza, the paralaterals are wanting. The sternum is shorter than the tergum, the caudal margin deeply emarginate with the ventral and ventro-lateral chalazae distinct. The tenth segment is not visible from the dorsal aspect, slightly setaceous, and appears to be cylindrical when viewed from the ventral aspect. The legs are long and slender, about one and one-half times as long as their thoracic segment is wide.

Anatis Mulsant

This genus is represented in my material by a single species.

Anatis 15-punctata Oliv.—The body is elongate, widest at the meta-

thorax. The dorsal portion of the head is dark colored while the ventral part of the face is white or yellow. The epicranial stem is absent, the epicranial arms extend cephalad and ventrad from the occipital foramen for a short distance and diverge widely laterad and ventrad; they become obsolete dorso-mesad of the antacoriae. The mouth is directed cephalo-ventrad. The mesothorax, metathorax, and the first eight abdominal segments bear short stout senti from one to five times as long as wide. The prothorax has a distinct parascoli on the caudo-lateral margin of the dorsal shield. There are four or five chalazae cephalad of this parascoli. The caudo-mesal portion of the dorsal shield is provided with a distinct yellow or white shield-shaped area, the cephalic portion of which bears two chalazae adjacent to the meson. The mesal and lateral tergal senti of the mesothorax and metathorax arise from the dorsal shields of their respective segments. The caudal portions of the lateral aspects of the mesothorax and metathorax are each provided with a small sentus. The mesothoracic spiracles are located in the mesocoria and the metathoracic spiracles are rudimentary or wanting. The thoracic sterna are all similar, the sternum of each segment has a pair of small verrucae adjacent to each other and the ventro-meson, the coxacoriae are distant. The first to eighth segments of the abdomen are subequal in length. Their terga are provided with four senti arranged in a transverse row; the dorsal senti of the sixth, seventh, and eighth segments have their pinacula fused on each segment, and the dorso-lateral senti of the seventh and eighth segments are short and inconspicuous. The metathorax and the first abdominal segment are each provided with a small cream-colored area caudad of and about one-half the distance between the dorsal and dorso-lateral senti. The lateral aspects of the first and second abdominal segments are white, each with a distinct white lateral sentus and pinaculum; the lateral aspects of the third to eighth segments are cream-colored with their senti and pinacula brown; the lateral aspects of the seventh and eighth segments are without lateral senti but are provided with lateral verrucae while ventrad of each lateral sentus or verruca, except in the first, ninth, and tenth segments, there is a distinct chalaza surrounded by a few setae which represent the paralateral group. The sterna of the first to the eighth segments are similar in shape, except that they become narrower toward the caudal extremity. The first sternum has two ventral chalazae adjacent to the meson, the ventro-laterals are wanting, while in sterna two to eight the ventral and ventro-lateral groups are present on each segment. In the eighth and ninth segments the ventral and ventro-lateral groups on each side have become fused so that there appears to be a single pair on each side of the meson. The tergum of the ninth segment is longer than wide, shield-shaped, and with many setae on its surface; its lateral aspect is much reduced and bears small and indistinct lateral verruca, the paralaterals

are wanting; and its sternum is provided with ventral and ventro-lateral chalazae. The tenth tergum is not visible from the dorsal aspect and the greater part of its ventral aspect is hidden by the evaginated rectal disk. The legs are long and slender, about one and one-half times as long as the metathorax is wide.

Coccinella Linné

The body is fusiform, elongate and widest at the metathorax. The head is usually light-brown colored and provided with many setae. The epicranial arms diverge immediately from the occipital foramen and become obsolete near the antacoriae. The mouth is directed ventrad and slightly cephalad. The thoracic segments are provided with a dorsal shield. The dorsal and dorso-lateral aspects of abdominal segments one to eight are provided with parascoli or verrucae, the ventro-lateral aspect with verrucae, and the ventral aspect with verrucae or chalazae surrounded by a few setae. The dorsum of the ninth abdominal segment is shield-shaped and densely setaceous, the ventral aspect is provided with verrucae or chalazae, and is about one-half as long as the dorsal aspect. The legs are well developed, stout, and extend beyond the lateral margins of the body. The coxacoriae are distant. The basal portion of the tarsal claw is provided with a distinct appendiculate tooth.

Species of Coccinella

Terga one to eight with distinct parascoli; prothoracic shield with two distinct, longitudinal, dark, heavily chitinized areas on each side of the meson.....*C. 9-notata*

Terga one to eight with strumae; prothoracic shield with a single, dark, heavily chitinized area on each side of the meson.....*C. sanguinea*

Coccinella 9-notata Herbst.—The body is fusiform, usually stout, and widest at the metathorax. The dorsal and dorso-lateral surfaces are provided with parascoli, and the ventro-lateral surface with small verrucae. The general color is light grayish-brown to dark tan or brown marked with white or lemon-yellow areas. The dorsal portion of the head is light-brown and the face is cream-colored. The epicranial arms diverge from the occipital foramen and the mouth is directed slightly ventrad and cephalad. The prothorax is wider than long and oval in outline; the dorsal shield covers the greater part of its dorsal surface and bears four distinct, dark-colored, longitudinal areas; and the cephalic, lateral, and part of the caudal margins are provided with chalazae. The mesothorax and metathorax are subequal in size, each is about twice as wide as long and each dorsal surface is provided with a small oval dorsal shield on each side of the meson. There is a small dorso-lateral parascolus on the caudo-lateral portion of both the mesothorax and metathorax. Each thoracic sterna is provided with a pair of verrucae which are adjacent to the ventro-meson.

The dorsal and dorso-lateral portions of abdominal segments one to eight are provided with parascoli. The dorsal parascoli are brown, while the dorso-lateral and lateral ones of the first and fourth segment are white or cream-colored, and also the area near the pinacula of these parascoli is white. Segments two to nine are provided with paralateral verrucae, while segment one has a small paralateral chalaza. The sterna of segments two to nine are provided with four verrucae arranged in a transverse row on each sternum; while the sternum of the first segment has only two verrucae, the ventro-lateral ones are absent. The ventral and ventro-lateral verrucae on either side of the meson of the ninth segment are almost fused so that there seems to be only two on this segment. The dorsal surface of the ninth segment is about twice as long as the ventral, shield-shaped, the caudal margin is rounded, and densely setaceous. The legs are well developed, long, and stout. The proximal portion of the tarsal claw is provided with a distinct appendiculate tooth.

Coccinella sanguinea Linn.—The body is elongate and widest at the metathorax. The dorsal and lateral surfaces are provided with strumae, and the ventral surface with verrucae or chalazae. The general color of the body is light to dark brown, mottled or spotted with yellow or cream-colored areas. The head is light brown and the face is yellow. The mouth is directed ventrad and slightly cephalad. The prothorax is about three-fourths as long as wide, and the caudal margin is slightly emarginated. The dorsal shield is light brown in color, entire, with a light yellow line on the meson, and the cephalic and lateral margins are provided with chalazae. The mesothorax and metathorax are subequal in size, about twice as wide as long, each with a small oval shield on either side of the meson. There is a light yellow area on the meson between the shields of each segment. The mesothoracic spiracles are located in the mesocoria cephalo-dorsad of the mesocoxacoilae, the metathoracic spiracles are rudimentary. The caudal portion of the lateral aspect of the mesothorax and metathorax bears a small verruca. The sterna of all of the thoracic segments are provided with a pair of small verrucae adjacent to each other and the meson. Abdominal segments one to eight are provided with dorsal and dorso-lateral strumae, and each segment bears more than five chalazae and a few scattered setae. The dorsal strumae of the fourth abdominal segment, the dorso-lateral strumae of the first and fourth segments, and the lateral strumae of the first, fourth, and fifth segments are white or light yellow. There is a small paralateral struma, which in many cases appears to be verruca-like, located ventrad of each lateral struma, except in the first abdominal segment where it is wanting. The sterna of segments one to nine are each provided with ventral and ventro-lateral groups of chalazae, except in the first segment, where the ventro-lateral groups are wanting. The dorsum of the ninth segment is shield-shaped with the

caudal margin rounded, is twice as long as its sternum, is dark colored, and bears many short setae. The legs are long, slender, well developed, and the tarsal claw is provided with a distinct appendiculate tooth at its proximal end.

Hippodamia Mulsant

The body is fusiform, elongate, and usually widest at the metathorax. The head is brown to dark colored and distinctly setaceous. The epicranial arms diverge immediately from the occipital foramen and become obsolete near the antacoriae. The mouth is directed ventrad and slightly cephalad. The dorsum of each thoracic segment is provided with distinctly chitinized shield-shaped areas which constitute the dorsal shields. The dorsal and dorso-lateral aspects of the body are provided with parascoli. The tergum of the ninth abdominal segment is shield-shaped, setaceous, and with the caudal margin broadly rounded. The ventro-lateral aspect of the body is provided with small strumae; while the sterna are all provided with verrucae. The legs are well developed, extend beyond the sides of the body, stout, and with the tarsal claw not provided with a distinct appendiculate tooth at its proximal end. The coxacoriae are distant.

Species of Hippodamia

Dorsal shield with two brown or black chitinized plates on each side of the meson.....*H. convergens*
Dorsal shield with a single brown or dark chitinized plate on each side of the meson.....*H. 13-punctata*

Hippodamia convergens Guer.—The body is elongate, widest at the metathorax, and the dorsal and lateral surfaces are provided with parascoli. The general color of the body is dark-brown to black, marked with yellow, orange, red, or white. The head is dark-brown to black, the face is lighter than the dorsal part. The epicranial arms diverge immediately from the occipital foramen and become obsolete dorso-mesad of the antacoriae. The mouth is directed ventrad and slightly cephalad. The prothorax, when viewed from above, is oval in outline and wider than long. The dorsal shield is provided with four longitudinal dark colored areas separated by white or orange colored bands. The cephalic and lateral margins of the dorsal shields are provided with chalazae. The dark plate-like spots also bear chalazae and resemble strumae. The mesothorax and metathorax are subequal in length. The dorsal surface of each is provided with parascoli, the pinacula of which have grown together on each side of the meson to form a basal shield. The cephalic portion of each lateral aspect of the mesothorax bears a mesothoracic spiracle, the metathoracic spiracle of each side is rudimentary. The caudo-lateral aspect of the mesothorax and metathorax are each provided with a distinct parascolus, the

mesothoracic one is brown and the metathoracic one is white or cream-colored. Each thoracic sternum is provided with a pair of verrucae adjacent to the meson. The terga of abdominal segments one to eight are provided with black or brown parascoli, except the fourth, in which the parascoli are orange colored. The dorso-lateral parascoli of segments one and four are also yellow or orange colored. The lateral aspect is provided with a row of lateral parascoli, those on the first and fourth segments are white and the remainder are brown. The lateral aspect is also provided with a row of brown paralateral strumae ventrad of the lateral parascoli. Sterna two to nine are provided with a transverse row of four verrucae on each segment, sternum one bears only two ventral verrucae which are adjacent on the ventro-meson, the ventro-lateral verrucae are absent. The dorsum of the ninth abdominal segment is shield-shaped, twice as long as its sternum, and provided with many setae or chalazae. The legs are well developed and extend beyond the sides of the body. The tarsal claw is without an appendiculate tooth.

Hippodamia 13-punctata Linn.—The body is slender, elongate, widest at the metathorax. The dorsal and lateral surfaces are provided with parascoli. The general color is brownish-tan to dark grayish-brown and the head is darker than the remainder of the body. The head is heavily chitinized, the epicranial arms do not meet but extend separately to the occipital foramen. The mouth is directed cephalo-ventrad. The prothorax is wider than long, and when viewed from above, is oval in outline. Its entire surface is covered with a solid brown dorsal shield which has a fine white line running along the dorso-meson. The cephalic, lateral, and caudal margins are provided with distinct chalazae. The mesothorax is slightly longer than the metathorax, about twice as wide as long, with a distinctly chitinized, oval, shield-shaped struma on either side of the meson. This struma bears ten to fifteen chalazae. The metathorax is more than twice as wide as long and provided with a chitinized shield-like struma on each side of the meson. This struma bears about as many chalazae as the mesothoracic strumae. The cephalic portion of the lateral aspect of the mesothorax and metathorax bears the thoracic spiracles. The mesothoracic spiracles are prominent and are located in the mesocoria cephalo-dorsad of the coxacoriae, the metathoracic spiracles are rudimentary. The caudal portion of the lateral aspect of the mesothorax is provided with a brown struma, while the metathorax is provided with a white struma. Each thoracic sterna is provided with two distinct verrucae adjacent to the ventro-meson. The legs are well developed and extend beyond the sides of the body. The tarsal claw is without a distinct appendiculate tooth. The terga of abdominal segments one to eight are provided with distinct dorsal parascoli located near the dorso-meson, those on the fourth abdominal segment are white. The lateral margins of terga

one to eight bear the dorso-lateral parascoli, the first and fourth are white and the remainder are brown to dark tan-colored. The ninth abdominal segment is longer than wide; its caudal margin is acutely rounded; its dorsal surface is brown colored, chitinized, and bears many chalazae and small setae. The lateral aspect of segments one to eight is provided with distinct lateral strumae, those on segments one and four are white. There is a small paralateral verruca ventrad of each lateral strumae. The lateral aspect of the ninth segment bears chalazae. The sterna of segments two to nine are provided with four chalazae arranged in a transverse row on each segment, the sternum of the first segment has only two chalazae present, the ventro-laterals are wanting.

Adalia Mulsant

This genus is represented in the material studied by a single species.

Adalia bipunctata Linn.—The body is elongate, oval in outline, the third and fourth abdominal segments are the widest. The general color is dark brown to bluish-gray, mottled with light yellow or cream-colored spots. The dorsal part of the head is dark brown to black and heavily chitinized, while the ventral portion of the front and clypeus is white or cream-colored. The epicranial stem is absent and the epicranial arms curve broadly laterad and mesad to the pretentorinae, giving the front a more or less circular appearance, then extend laterad from the pretentorinae toward the antacoriae near which they become obsolete. The mouth is directed cephalo-ventrad. The prothorax is crossed longitudinally by a median and two lateral yellow stripes. The dorsal shield is not united to the meson of the mesothorax and metathorax and the two portions are separated by a cream-colored area. The lateral aspect of the prothorax is glabrous. The cephalic portion of the mesothorax and metathorax is also glabrous; while the caudal portion is large and bears a small but distinct struma on each segment. The mesothoracic and metathoracic spiracles are located in the coriae between the segments. The thoracic sterna are distinct, each sternum bears a pair of small verrucae near its cephalic margin. The coxacoriae are distant. Abdominal segments one to eight are each provided with a transverse row of four strumae on the tergum. The mesal portions of the dorsal strumae of the fourth segment are white, while the lateral portions are brown, the dorso-lateral strumae of the first segment are surrounded by a distinct white area, and the dorso-lateral strumae of the second to the eighth segments are surrounded by a much smaller white area. Each struma is provided with three to five prominent chalazae. The lateral aspect of segments one to eight is yellow and the strumae are brown except on the fourth segment where they are light yellow. There is a small but distinct chalaza on each segment ventrad of the lateral strumae of segments one to eight which is surrounded by a few

setae representing the paralateral group. The ninth tergum is shield-shaped, longer than wide, the caudal margin concave and provided with numerous setae, while the cephalic margin bears only a few chalazae. The tenth tergum is visible from the dorsal aspect as a small, brown colored, chitinized area caudad of the ninth tergum and is provided with a single chalaza on each side of the meson. Each of these chalaza is surrounded by a group of small setae. The ninth sternum is about one-half as long as its tergum, deeply emarginate on its caudal margin, and bears two chalazae on each side of the meson, each of which is surrounded by a few setae. The tenth sternum is longer than its tergum and bears a dark colored spot near the lateral margin. The legs are slender, well developed, and longer than the body is wide.

Microweiseini

The body is small, elongate, fusiform, depressed, widest at the metathorax, provided with setae, and light-brown to yellowish-tan colored. The head is dark-brown to black in color and chitinized. The mouth is directed cephalo-ventrad and the mandibles are unidentate. The epicranial arms diverge slowly from the occipital foramen and become obsolete near the antacoriae. The spear-shaped front and post-clypeus are divided on the meson by a distinct, dark colored, chitinized bar which extends from the occipital foramen to the clypeo-labral suture. The prothorax is oval and slightly wider than long; while the mesothorax and metathorax are distinctly wider than long. The terga of the thoracic segments are longitudinally crossed by a small dark-colored area on each side of the meson, more distinct on the prothorax than on the mesothorax or metathorax. The ninth abdominal segment is conical, narrower than the eighth, and about twice as long as wide. The legs are well developed and extend beyond the sides of the body; the tibiae are provided with two paddle-shaped tenent hairs at the distal end; the tarsal claw bears a distinct appendiculate tooth; and the coxacoriae are distant.

MICROWEISEA Cockerell

This genus is represented in the material studied by a single species.

Microweisea misella Le Conte.—The body is fusiform, elongate and light-brown to yellowish-tan in color. The head is elongate, dark colored, and chitinized. The epicranial arms are present, but the epicranial stem is wanting. There is a dark-brown heavily chitinized bar extending along the dorso-meson from the occipital foramen to near the clypeo-labral suture. The mouth is directed cephalad. The prothorax is wider than long and somewhat oval in outline. There are two brown chitinized spots near the middle of the dorsum adjacent to the meson. The dorsum is provided with a very few short setae. The mesothorax and metathorax

are about twice as wide as long; and the lateral margin of each is provided with a fringe of fine setae. The sterna of the thoracic segments are equal in size to that of their respective terga. The prosternum appears to be glabrous; while there is a pair of small verrucae adjacent to the ventromeson of the metathorax and mesothorax. These verrucae are provided with setae which are about as long as their segments. The coxacoriae are distant and placed near the lateral margins of the sterna. The legs are small, well developed, and extend beyond the sides of the body. Each tibia is provided with two paddle-like tenent hairs placed near the distal end of the segment, the tarsal claw bears a distinct appendiculate tooth. Abdominal segments one to eight are similar, except that they become successively smaller. Each tergum is provided with a few small setae which are never as long as the segments. The dorsum of the eighth segment is dark, chitinized, and its caudal margin is not emarginate. The sterna and the lateral aspects of segments one to eight are similar in general size and structure. They are membraneous and provided with a few small setae. The coriae between the segments are distinct. The sternum of the eighth segment is deeply emarginate on its caudal margin. The ninth segment is longer than wide, its caudal margin narrower than the cephalic. The tergum is shield-shaped, dark-colored, chitinized, and the caudal margin is acutely rounded and bears many setae about one-half as long as the segment is wide. The shape of the ninth sternum is similar to that of its tergum, it is very slightly chitinized and supplied with only a few setae. The tenth segment is cylindrical, directed caudo-ventrad; the rectum is evaginated to form a sucking disk.

Scymnini

The body is small, elongate, fusiform, widest caudad of the metathorax, provided with verrucae or chalazae and setae, and light-yellow to light-brown in color. The head is slightly chitinized, light colored, densely setaceous, and directed cephalad. The epicranial suture is wanting. The prothorax is oval, slightly chitinized, and provided with verrucae. The mesothorax and metathorax are about twice as wide as long and are provided with verrucae on the dorsal surfaces and with chalazae and setae on the lateral and ventral surfaces. The abdominal segments are provided with verrucae on the dorsal and lateral surfaces and with chalazae and setae on the ventral. The ninth abdominal segment is cylindrical, about twice as long as wide and the sternum is shorter than the tergum. The legs are well developed and extend beyond the sides of the body, the tibiae bear more than two tenent hairs, and the coxacoriae are distant.

Scymnus Kugelann

This genus is represented in my material by a single species which could not be determined.

Scymnus sp.?—The body is fusiform, elongate, flattened, light-yellow or cream-colored to light-brown. The head is circular in outline, very slightly chitinized, and provided with numerous black setae which are about one-half as long as the body is wide. The epicranial suture is entirely wanting and the mouth is directed cephalad. The prothorax is slightly wider than long, and the dorsum bears the light-brown slightly chitinized dorsal shield. The cephalic margin is provided with six large black setae which are about one-third as long as the segment, the caudal margin has six setae of about the same size as the cephalic setae, but not so darkly colored; midway between the cephalic and caudal rows there is another of four long black setae. The mesothorax is distinctly narrower and shorter than the metathorax which is broadly emarginate on its caudal margin. Both the mesothorax and metathorax have an oval-shaped verruca on either side of the dorso-meson. This verruca is provided with setae which are about as long as the verruca is wide. The thoracic sterna are distinct. Those of the mesothorax and metathorax are provided with a few setae; while the prothoracic sternum is glabrous. The coxacoriae are distant and the legs are well developed, usually white or light-yellow in color, and extend beyond the margins of the body. Each tibia is provided near the distal end with six to eight tenent hairs. The tergum of the first abdominal segment is distinctly longer than the second. Each tergum of abdominal segments one to eight is provided with a transverse row of four distinct verrucae. The dorsal verrucae are adjacent to the dorso-meson and the dorso-lateral are near the lateral margin of the tergum in each segment. The lateral aspect of segments one to seven is lobed and each lobe bears a distinct verruca with setae as long as the segment bearing them. The lateral aspect of the eighth segment bears two or three chalazae about as long as the setae on the verrucae. There are on segments two to eight one or two distinct paralateral chalazae immediately ventrad of the lateral verrucae and chalazae, while the first segment bears a small paralateral seta. The sterna of segments one to eight are similar to their terga in size and shape. The cuticle is membraneous and bears on each segment a transverse row of small setae. The coriae are distinct. The ninth abdominal segment is longer than wide, slightly chitinized, and marked with a dark spot near the middle and on either side of the dorso-meson. The tergum is shield-shaped and provided with many dark colored setae. The lateral aspect of the segment appears to be glabrous. The sterna is shorter than the tergum, the cuticle is membraneous and armed with a transverse row of four small setae. The tenth abdominal segment is cylindrical, glabrous, directed caudo-ventrad and bears the large disk-like sucker.

Hyperaspini

The body is ovate and the first to the fourth abdominal segments are widest. The prothorax is wider than long and the caudal margin is longer than the cephalic. The ninth abdominal segment is directed ventrad, wider than long, the tergum very slightly chitinized and provided with a few small setae. The body is usually white or yellow in color. The larvae cover themselves with flocculent masses of wax-like excretion. The body is never provided with scoli, senti, strumae, or verrucae, but is usually armed with setae or small chalazae. In the early larval stages the epicranial suture is present, while in the adult larval stages the epicranial suture is wanting. The antennae are short, three-segmented, and slightly setaceous. The mandibles are provided with a slightly developed mola and the apex is never bifurcate.

Genera of Hyperaspini

Cephalic margin of the prothorax with setae about as long as the prothorax is wide and lateral tergal abdominal setae are about twice as long as the segments bearing them.....*Brachyacantha*

Cephalic margin of the prothorax with setae which are not as long as the prothorax is wide and the lateral tergal abdominal setae are shorter than the segments bearing them.....*Hyperaspis*

BRACHYACANTHA Chevrolat

This genus is represented by a single species.

Brachyacantha ursina Fab.—The dorsal portion of the head is slightly chitinized. The head is light yellow in color; the mouth is directed ventrad and slightly cephalad. The body is elongate, widest at the second and third abdominal segments, white to light-cream-colored, usually covered with a flocculent wax-like excretion. The prothorax is one-half as long as wide. The dorsal shield is wanting, but the cephalic margin of the prothorax bears eight setae which are longer than the segment is wide, the lateral margin bears two setae which are also longer than the segment. The lateral aspect is poorly defined and glabrous; the sternum is small and without setae. The mesothorax and metathorax are each about three times as wide as long, are provided with a seta near the lateral margin which is longer than the segment, and the lateral aspects are not well defined. The mesothoracic spiracles are located in the mesocoria near the cephalic margin of the segment, the metathoracic spiracle is wanting or rudimentary. The legs are short and not well developed, rarely extending beyond the sides of the body. Abdominal segments one to eight are similar. The terga are strongly convex, the dorsal and dorso-lateral setae are longer than the segments bearing them, and the spiracles are located near the cephalo-ventral margin of each tergum. The lateral aspect of each segment is provided with two large setae which are not longer than

the segments bearing them, the lateral setae are larger than the paralateral ones. The sterna are flat; each, except the first, bears a transverse row of four large setae. In the first segment the ventro-lateral setae are wanting. The caudal margins of the seventh and eighth sterna are deeply emarginate. The tergum of the ninth segment is semicircular, about as wide as long, and the dorsal surface is densely setaceous. The ninth sternum is small and bears four small setae. The tenth segment is small, cylindrical, glabrous, and directed ventrad.

Hyperaspis Redtenbacher

The members of this genus are generally white to cream-colored, and the body is usually covered with a flocculent wax-like mass. When seen from the dorsal aspect, the body is oval to elongate in outline, the dorsum is strongly convex and the sternum is more or less flattened. The prothorax is wider than long and bears setae which are not as long as the prothorax is wide. The ninth abdominal segment is semicircular, wider than long, and usually retracted into the eighth segment. The legs are small, short, and well developed. The mandibles are unidentate and serve as piercing organs. The members of this genus are carnivouous living for the most part upon aphids and soft-bodied coccids.

Species of Hyperaspis

Body elongate-ovoid and densely covered with dark hair-like setae ..... *H. binotata*

Body oval, not elongate, apparently glabrous, but with a few small inconspicuous setae ..... *H. signata*

Hyperaspis binotata Say.—The dorsal aspect of the body is brownish-yellow to yellowish-gray; the front, vertex, and clypeus are spotted with light or dark brown areas and provided with numerous setae. The prothorax is about twice as wide as long and the cephalic and lateral margins bear setae as long as the segment. The mesothorax and metathorax are subequal in length, but the latter is the wider. The lateral margin of the mesothorax is provided with a group of setae about as long as the segment, while the lateral margin of the metathorax has a distinct chalaza on each side which is surrounded by a group of long setae. The lateral margins of abdominal segments one to eight are each provided with a chalaza surrounded by a distinct group of setae. The dorsal surface of the thoracic and abdominal segments are densely covered with short black setae. The sterna and lateral aspects of the entire larva are provided with numerous fine and inconspicuous setae. The tergum of the ninth abdominal segment is about twice as wide as long, not strongly chitinized, and the caudal and lateral margins bear setae which are longer than the segment. The sternum is about one-half as long as the tergum and deeply emarginate on

the caudal margin. The tenth segment is small, cylindrical, and slightly chitinized, with a few fine setae on its surfaces. The segment is usually directed caudo-ventrad. The rectum has been evaginated to form a sucking disk. The legs are short and well developed, but do not extend beyond the sides of the abdomen in the adult larvae. The coxacoriae are distant.

Hyperaspis signata Oliv.—The general form of the body is oval, the dorsal surface is globose. The body is usually light-yellow to yellowish-green in color. The dorsal aspect of the head is brown, tan, or yellowish gray. The cephalic portions are spotted with small brown or black areas. The head is provided with many setae which are usually the longest setae found on the entire body. The tergum of the prothorax is rectangular and about twice as wide as long. The dorsal shield is wanting and the lateral and caudal surfaces are provided with setae which are about as long as the segment. The mesothorax and metathorax are subequal in length, but the metathorax is wider than the mesothorax. The lateral margins of both of these segments are provided with a few short setae which are not as long as the segment. The dorsal aspect of abdominal segments one to eight are similar and strongly convex, with a very distinct coria between the segments, and never densely setaceous but provided with a few setae which are never as long as the segment bearing them. The lateral margin of the dorsal aspect of the abdomen is provided with a series of lobes between the annulets. These lobes are provided with a few setae which are not as long as the segment. The sterna and the lateral aspect of segments one to eight are provided with a few short setae which are almost invisible. The tergum of the ninth abdominal segment is more or less shield-shaped, more than twice as wide as long, with the caudal margin broadly rounded. The lateral and caudal margins bear setae which are not as long as the segment. The ninth sternum is about one-half as long as the tergum, its cephalic margin is broadly convex while the caudal margin is deeply emarginate. The sternum and the lateral aspects are provided with a few small setae. The tenth abdominal segment is retracted into the ninth so that, as a rule, it is not visible. The tenth segment is small, circular, and membraneous. The rectum is evaginated to form a sucking disk. The legs are small, dark brown, and well developed, but do not extend beyond the sides of the body.

BIBLIOGRAPHY

ARROW, GILBERT J.
1918. Life History of Scymnus capitatus. Entom. Monthly Mag., 54: 8-9.

BANKS, CHAS. S.
1906. Principal Insects Attacking Coconut Palm (Part II). Philippine Jour. Sci., 211-228; 10 pls.

BEUTENMUELLER, WM.
1891. Bibliographical Catalogue of the Described Transformations of North American Coleoptera. Jour. N. Y. Micros. Soc., 7:1-52.

BLATCHLEY, W. S.
1910. An illustrated Descriptive Catalogue of the Coleoptera or Beetles (Exclusive of the Rhynchophora) Known to Occur in Indiana. Indianapolis. 8vo. Pp. 506-533.

BÖVING, ADAM.
1917. A Generic Synopsis of the Coccinellid Larvae in the United States National Museum, with a Description of the Larvae of Hyperaspis binotata Say. Proc. U. S. Nat. Museum, 51:621-650; 4 pls.

BRITTON, W. E.
1914. Some Common Lady Beetles of Connecticut. Bull. Conn. Agr. Exp. Sta., 181, Ent. Series 19:1-24.

CASEY, THOS. L.
1899. A Revision of the American Coccinellidae. Jour. N. Y. Entom. Soc., 7:71-169.

CLAUSEN, C. P.
1915. A Comparative Study of a Series of Aphid-feeding Coccinellidae. Jour. Econ. Entom., 8:487-491.

COMSTOCK, J. H.
1893. Evolution and Taxonomy. Wilder Quarter-Century Book. Pp. 37-113. 3 pls.

COMSTOCK, J. H., and KOCHI, C.
1902. The Skeleton of the Head of Insects. Amer. Nat., 36:13-45.

COQUEREL, C.
1849. Observations entomologiques sur divers Coleopteres recuellis aux Antilles. Ann. soc. ent. France (2), 7:441-454.

DIMMOCK, G. W.
1906. Algunas Coccinellidae de Cuba. Primer Informe Anual de la Estación Central Agronómica de Cuba, 287-392; 3 pls.

FRENCH, G. H.
1883. Preparatory Stages of Epilachna borealis, Fab. Can. Entom., 15:189-191.

GANGLBAUER, L.
1899. Die Käfer von Mitteleuropa. 8°. Vol. 3. Pp. 941-1023.

HILTON, W. A.
1902. The Body Sense Hairs of Lepidopterous Larvae. Amer. Nat., 36:561-578.

LENG, CHARLES W.
1903. Notes on Coccinellidae. Jour. N. Y. Entom. Soc., 11:35-45; 193-213; 2 pls.

LETZNER, K.
1857. Beiträge zur Verwandlungsgeschichte der Coccinellen. Zeit. f. Ent., 11:3-24; 1 pl.

LEWCOCK, G. A.
1893. Note on Coccinella ocellata, L. Entomologist, 26:249.

PALMER, MIRIAM A.
1914. Some Notes on Life History of Ladybeetles. Ann. Ent. Soc. Amer., 7:213-238; 2 pls.

SIMANTON, F. L.
1916. Hyperaspis binotata, A Predatory Enemy of the Terrapin Scale. Jour. Agri. Res., 6:197-203; 2 pls.

WEISE, JULIUS.
1879. Bestimmungs-Tabellen der europäischen Coleoptern. II. Coccinellidae. Zeitschr. für Ent., n. F. 7:88-156.

PLATE I

EXPLANATION OF PLATE

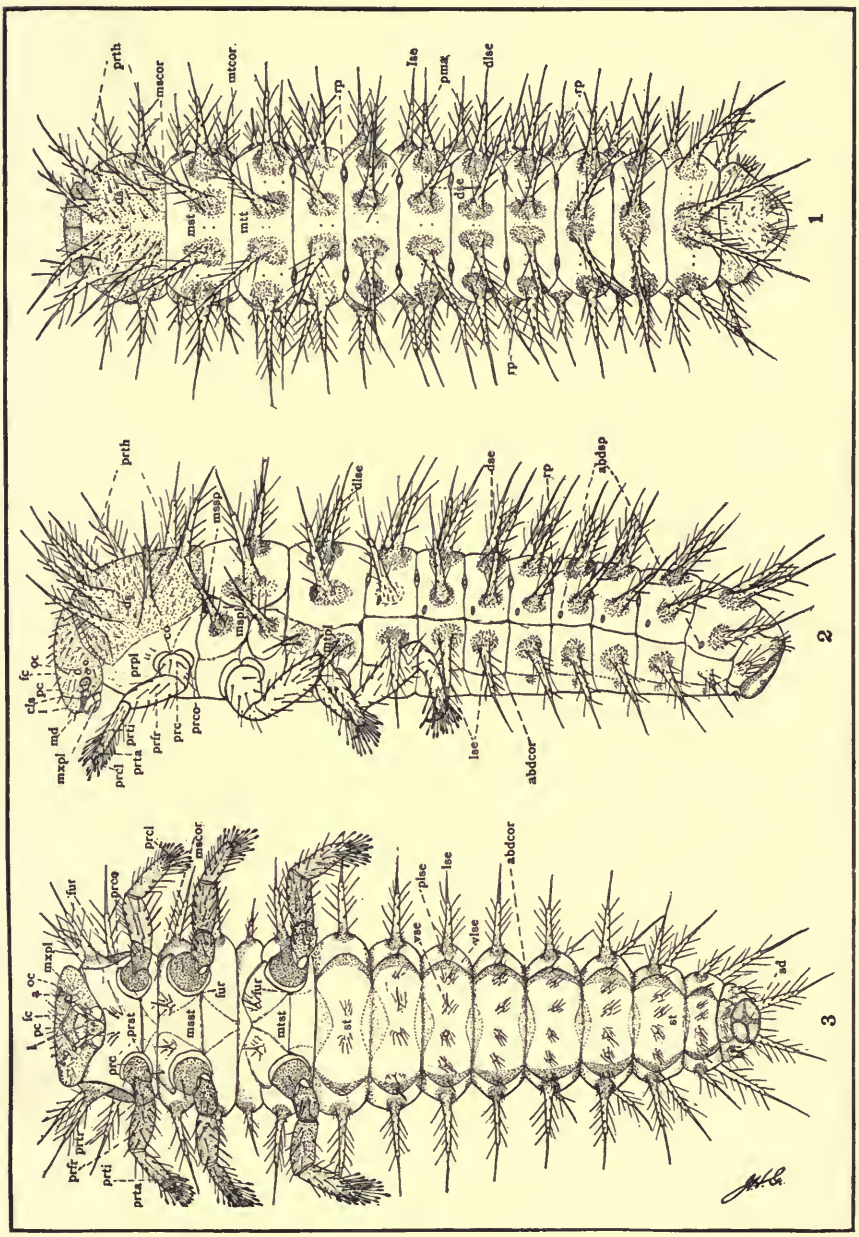
CHILOCORUS BIVULNERUS

Fig. 1. Larva, dorsal aspect.

Fig. 2. Larva, lateral aspect.

Fig. 3. Larva, ventral aspect.

abdcor	abdominal coria
abdsp	abdominal spiracle
cls	clypeo-labral suture
co	coxacoria
dse	dorsal senti group
dlse	dorso-lateral senti group
ds	dorsal shield
fc	front and postclypeus
fur	furcinia
l	labrum
lse	lateral senti group
md	mandible
mscor	mesocoria
mspl	mesopleural area
msst	mesosternum
mssp	mesothoracic spiracle
mst	mesotergum
mtcor	metacoria
mtpl	metapleural area
mtst	metasternum
mtt	metatergum
mxpl	maxillary palpus
oc	ocelli
pc	preclypeus
plse	paralateral senti group
pma	points of muscle attachment
prc	procoxa
prco	procoxacoria
prcl	protarsal claw
prfr	profemur
prpl	propleural area
prst	prosternum
prta	protarsus
prti	protibia
prth	prothorax
prtr	protrochanter
rp	repugnatorial pore
sd	sucking disk
st	sternum
t	tergum
vlse	ventro-lateral senti group
vse	ventral senti group



GAGE LARVAE OF THE COCCINELLIDAE PLATE I

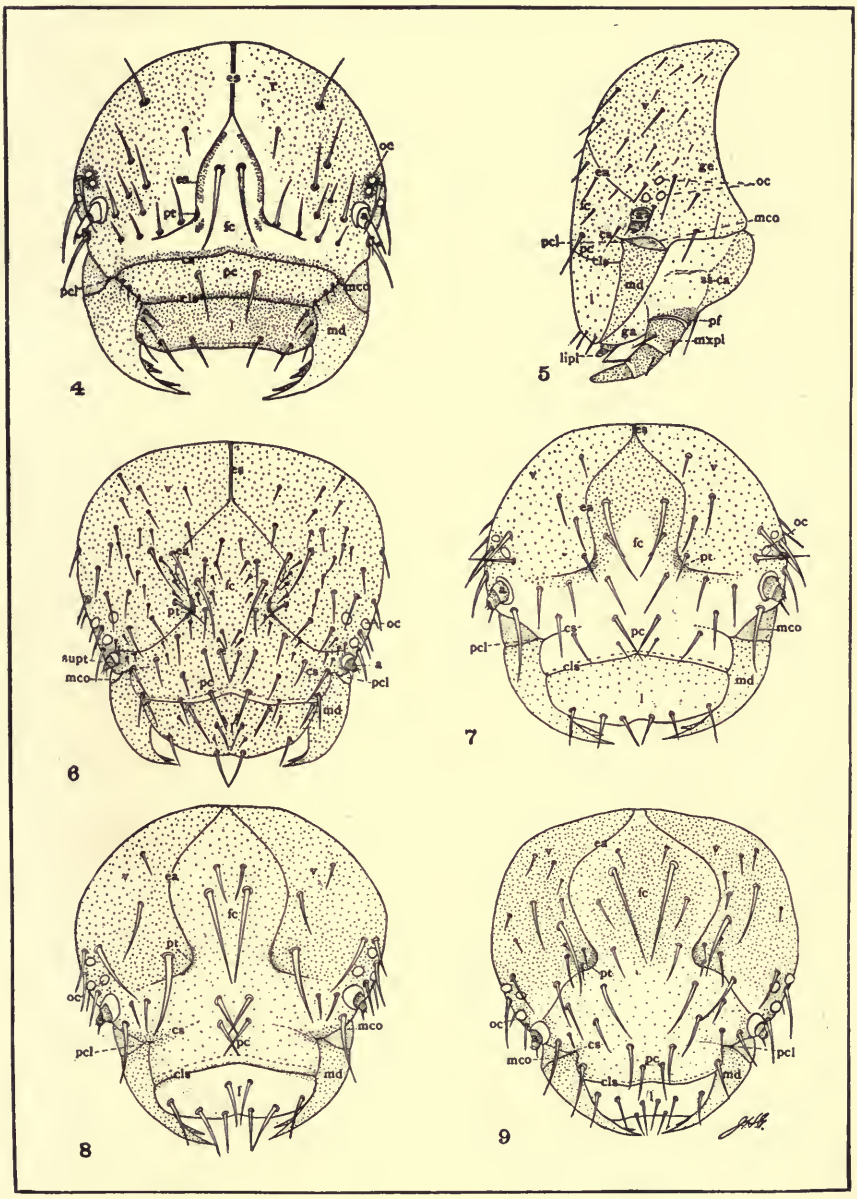
PLATE II

EXPLANATION OF PLATE

CEPHALIC ASPECT OF THE HEAD

Fig. 4. *Epilachna borealis.*
Fig. 5. *Chilocorus bivulnerus*, lateral aspect.
Fig. 6. *Chilocorus bivulnerus.*
The label *cls* for the clypso-labral suture is wanting.
Fig. 7. *Megilla maculata.*
Fig. 8. *Hippodamia 13-punctata.*
Fig. 9. *Hippodamia convergens.*

a	antenna
cls	clypeo-labral suture
cs	clypeal suture
ea	epicranial arms
es	epicranial stem
fc	front and clypeus
ga	galea
ge	gena
l	labrum
lipl	labial palpus
md	mandible
mco	mandacoria
mxpl	maxillary palpus
oc	ocelli
pc	preclypeus
pcl	precolia
pf	palpifer
pt	pretentorina
ss+ca	fused stipes and cardo
supt	supratentorina
v	vertex



GAGE LARVAE OF THE COCCINELLIDAE PLATE II

PLATE III

EXPLANATION OF PLATE

CEPHALIC ASPECT OF THE HEAD

Fig. 10. *Coccinella 9-notata.*

Fig. 11. *Anatis 15-punctata.*

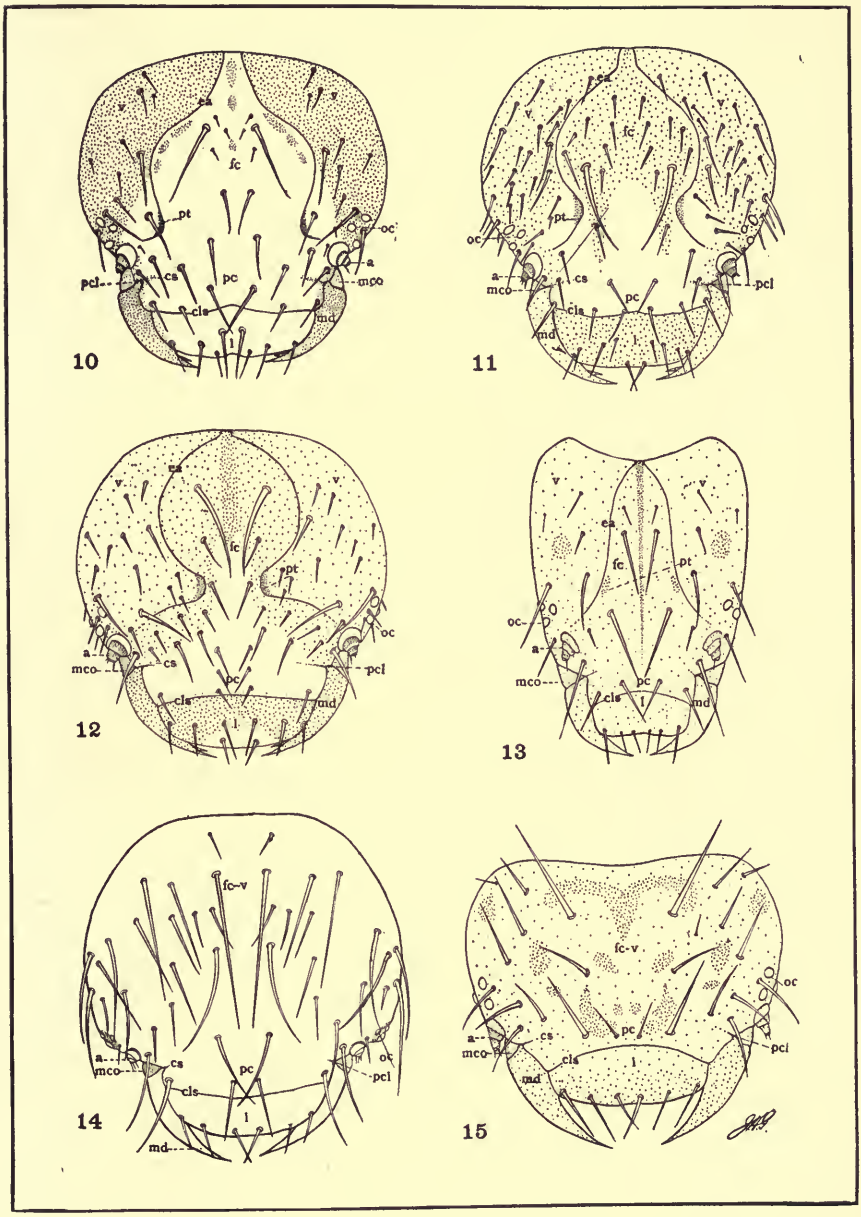
Fig. 12. *Adalia bipunctata.*

Fig. 13. *Microweisea misella.*

Fig. 14. *Scymnus* sp.

Fig. 15. *Hyperaspis binotata.*

a	antenna
cls	clypeo-labral suture
cs	clypeal suture
ea	epicranial arms
fc	front and postclypeus
fc+v	front, postclypeus and vertex
l	labrum
md	mandible
mco	mandacoria
oc	ocelli
pc	preclypeus
pcl	precoila
pt	pretentorina
v	vertex



GAGE LARVAE OF THE COCCINELLIDAE PLATE III

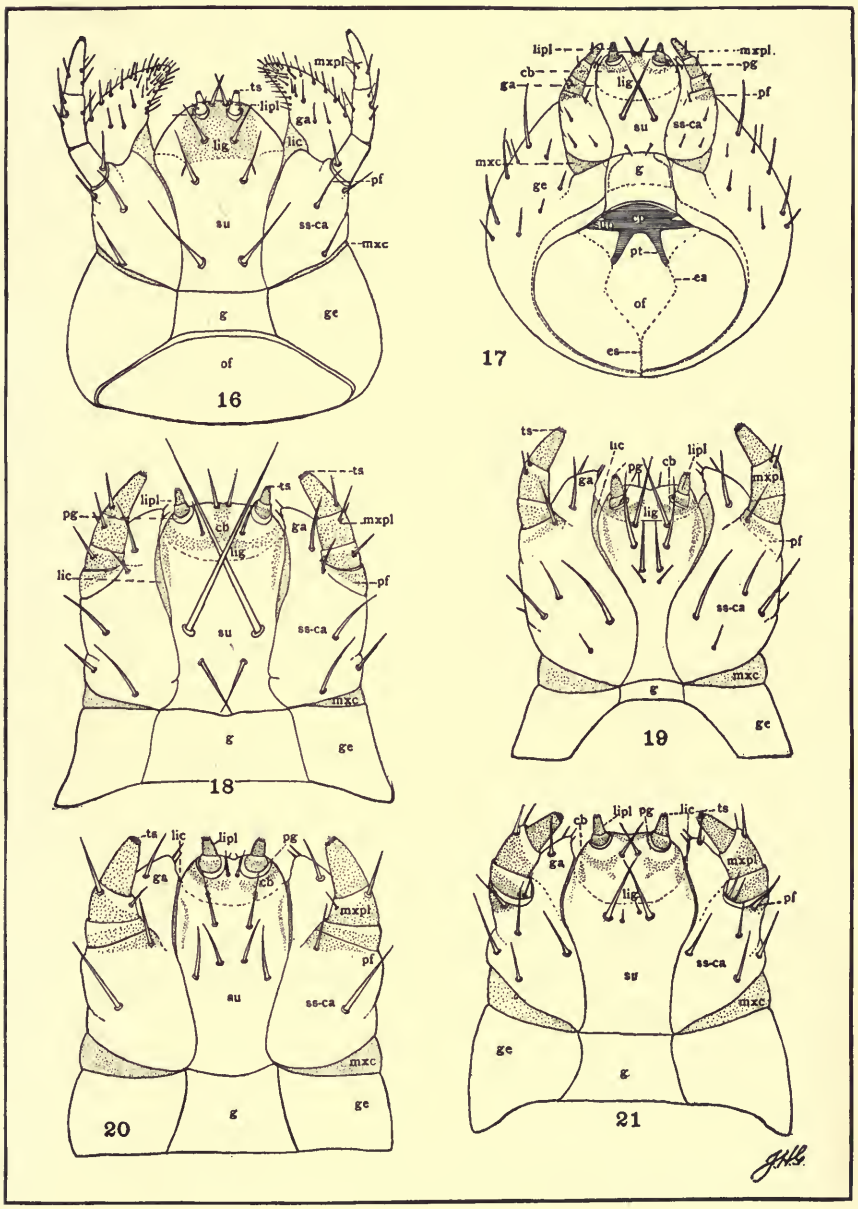
PLATE IV

EXPLANATION OF PLATE

VENTRAL ASPECT OF THE HEAD

Fig. 16. *Epilachna borealis.*
The Label *Pg* for the palpiger is wanting.
Fig. 17. *Chilocorus bivulnerus*, caudal aspect.
Fig. 18. *Chilocorus bivulnerus.*
Fig. 19. *Megilla maculata.*
The Label *su* for the submentum is wanting.
Fig. 20. *Hippodamia 13-punctata.*
The Label *lig* for ligula is wanting.
Fig. 21. *Hippodamia convergens.*

cb	chitinous band
cp	corpotentorium
ea	epicranial arms
es	epicranial suture
g	gula
ga	galea
ge	gena
lic	labiacoria
lig	ligula
lipl	labial palpus
mxc	maxacoria
mxpl	maxillary palpus
of	occipital foramen
pf	palpifer
pg	palpiger
pt	pretentorina
ss+ca	fused stipes and cardo
su	submentum
sup	supratentorium
ts	tactile setae



GAGE LARVAE OF THE COCCINELLIDAE PLATE IV

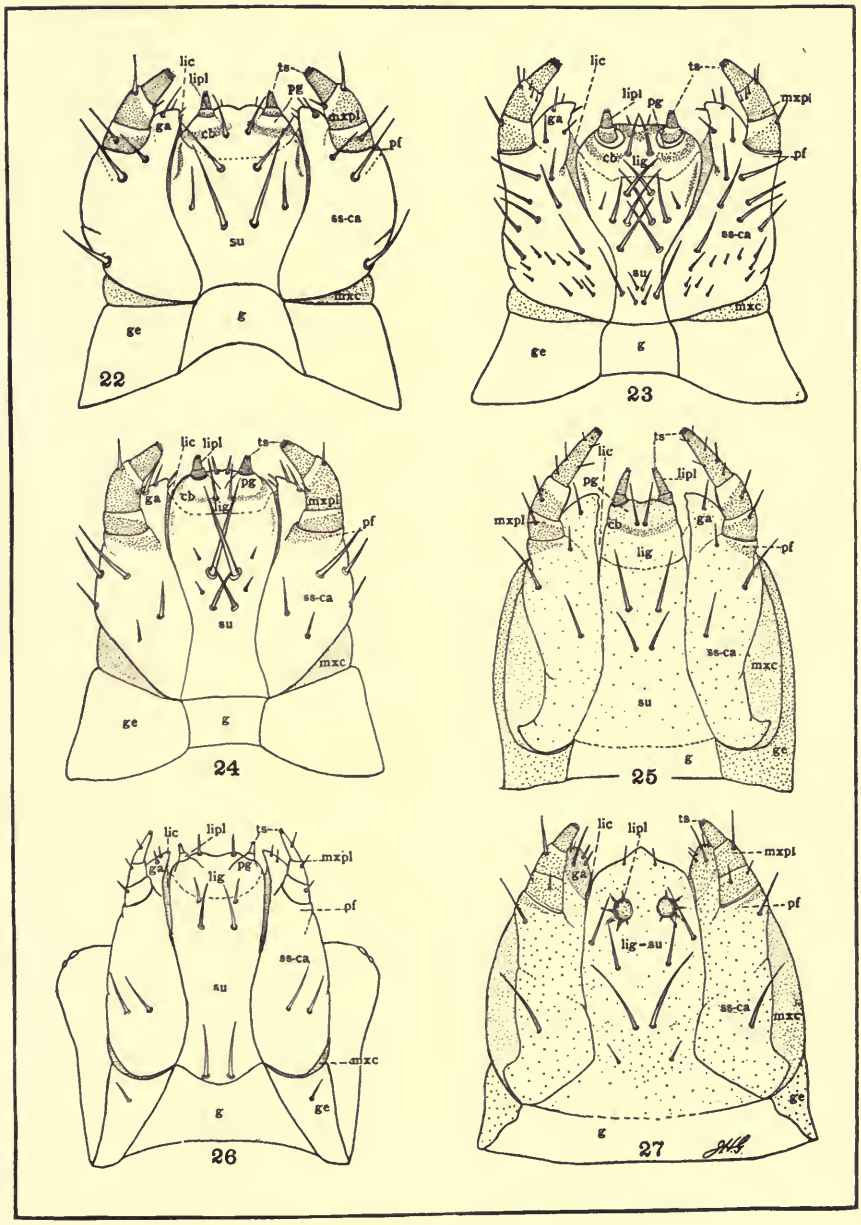
PLATE V

EXPLANATION OF PLATE

VENTRAL ASPECT OF THE HEAD

Fig. 22. *Coccinella 9-notata.*
Fig. 23. *Anatis 15-punctata.*
Fig. 24. *Adalia bipunctata.*
Fig. 25. *Microweisea misella.*
Fig. 26. *Scymnus* sp.
Fig. 27. *Hyperaspis binotata.*

cb	chitinous band	mxc	maxacoria
g	gula	*mxpl*	maxillary palpus
ga	galea	*pf*	palpifer
ge	gena	*pg*	palpiger
lic	labiacoria	*ss+ca*	fused stipes and cardo
lig	ligula	*su*	submentum
lipl	labial palpus	*ts*	tactile setae



GAGE LARVAE OF THE COCCINELLIDAE PLATE V

PLATE VI

EXPLANATION OF PLATE

MISCELLANEOUS PARTS OF THE BODY

Fig. 28. Scolus, *Epilachna borealis.*
Fig. 29. Sentus, *Chilocorus bivulnerus.*
Fig. 30. Parascolus, *Hippodamia convergens.*
Fig. 31. Struma, *Megilla maculata.*
Fig. 32. Verruca, *Microweisea misella.*
Fig. 33. Chalaza, *Hippodamia convergens.*
Fig. 34. Seta, *Hyperaspis binotata.*
Fig. 35. Antenna, *Epilachna borealis.*
Fig. 36. Antenna, *Chilocorus bivulnerus.*
Fig. 37. Antenna, *Hippodamia convergens.*
Fig. 38. Antenna, *Hyperaspis binotata.*
Fig. 39. Antenna, *Scymnus* sp.
Fig. 40. Mandible, *Chilocorus bivulnerus*, lateral aspect.
Fig. 41. Mandible, *Chilocorus bivulnerus*, mesal aspect.
Fig. 42. Mandible, *Microweisea misella.*
Fig. 43. Tarsus, *Chilocorus bivulnerus.*
Fig. 44. Tarsus, *Microweisea misella*, lateral aspect.
Fig. 45. Tarsus, *Microweisea misella*, ventral aspect.
Fig. 46. Tip of labial palpus, *Chilocorus bivulnerus.*
Fig. 47. Tentorium, *Chilocorus bivulnerus.*

ant	antennaria
antc	antacoria
at	appendiculated tooth
cp	corpotentorium
ea	epicranial arms
es	epicranial stem
d	dentes
fl	flagellum
met	metatentoria
mo	mola
pd	pedicel
poa	postartis
prt	pretentorium
ps	preartis
sc	scape
se	sensoria
sup	supratentorium
tc	tarsal claw
te	tenent hair
ti	tibia
ts	tactile setae

GAGE LARVAE OF THE COCCINELLIDAE PLATE VI

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